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Novel Features in Flume and Penstock Design: The Puntledge River Power Development, Vancouver, B. C.*

The firm Canadian Collieries (Dunsmuir) Ltd., of Victoria, B. C., owns and operates a group of coal mines in the vicinity of Union Bay, Vancouver Island, and the power for the operation of these coal mines heretofore has been generated by separate steam plants at the various mines. Some three years ago the problem of renovating and enlarging some of these plants presented itself for solution in the near future. General estimates were made of the capital cost of such improvements and also of a central steam-electric power station with a distribution system to the respective mines. At the same time surveys were made to determine the cost of available hydro-electric power for the same purpose. Comparative estimates showed that with coal (showing a calorific value of 14,000 B.t.u. per lb.) at $2.50 per ton delivered at the power station, the cost of installation and operation was greatly in favor of the hydro-electric development, and this method was accordingly adopted.

The available power was that of the Puntledge River, which is the outlet of a lake of the same name about eight miles from Comox Harbor, with an area of approximately 9 sq.mi. and a low-water level 420 ft. above tidewater. Puntledge River has an observed flow ranging between 330 and 3500 sec.-ft. (cu.ft. per sec.) and, by building an impounding dam at the outlet of the lake to raise the water 23 ft. and cutting the bottom of the outlet to a depth of 5 ft. below low water, an available storage capacity of 23 ft. of depth is obtained, equivalent to about 132,000 acre-feet. Considering with this the regimen of the river, as recorded during the short period of observed flow, it is estimated that a constant flow of at least 800 sec.-ft. can be maintained for the development of power. The rated capacity of the ultimate plant will be about 19,000 hp. at the turbine shaft; this being in excess of the requirements for the owner's own industries, the spare power is intended to supply other industries either established or contemplated in the district.

From the impounding dam, the water flows in the natural bed of the river to an intake reservoir formed in the bed of the river by a diversion dam about 2½ miles below the lake. This dam consists of a spillway and an intake with head gates, which divert the water for power development into a canal and flume line 3400 ft. long, the latter discharging into a forebay forming the intake of the penstock system. From the forebay the water is carried in a wood-stave pipe, 8 ft. in diameter and 5380 ft. long to a Y structure with two outlets for pipes 6 ft. in diameter fitted with 6-ft. gate valves. The next section of the present system consists of one line of 6-ft. stave pipe which is to be duplicated at some future time as only one-half of the ultimate penstock system is now built from this Y to the power house. This 6-ft. pipe is 4500 ft. long and it leads to a junction structure having inlets for two 6-ft. pipes and outlets for four 50-in. pipes, the interior of this structure forming a common chamber. Gate valves are installed here at both the inlets and the outlets. The penstocks from this point down are 50 in. in diameter; there are to be four in the completed system but only two are constructed for present purposes. These two 50-in. pipes are built of wood staves and steel bands for a distance of 3170 ft.; for the remaining distance of 660 ft. to the power house the pipes are of steel. Only one-half of the projected generating machinery has been installed, there being two reaction-type turbines with their horizontal shafts direct connected to alternating-current generators of revolving-field 25-cycle three-phase type.

As seen from the foregoing outline, the plant differs but little in general outline from the usual scheme of such hydro-electric development. But looking at further details, there are some features of unusual design and these are noted in what follows.

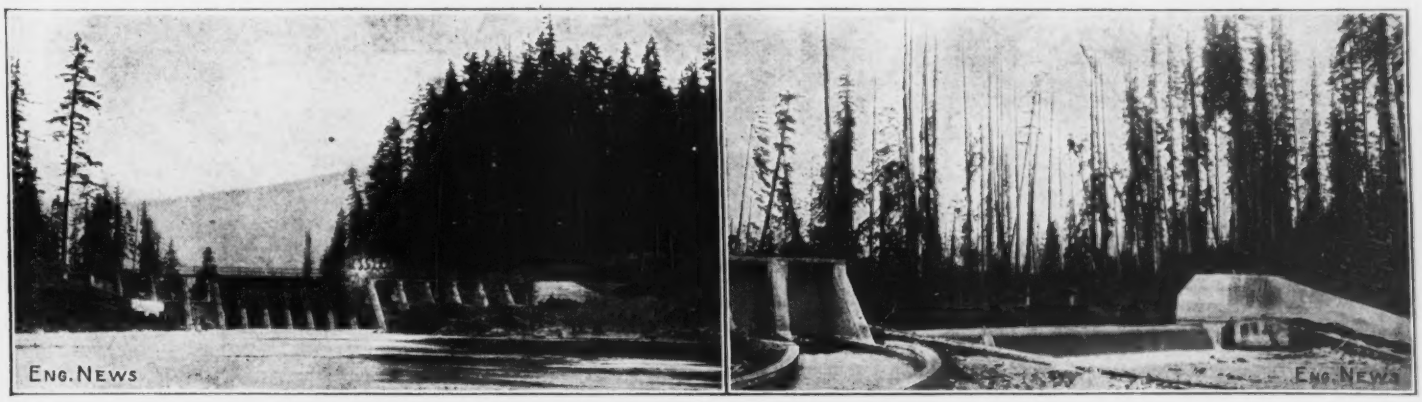


FIG. 1. IMPOUNDING AND DIVERSION DAMS, PUNTLEDGE DEVELOPMENT

*From notes, drawings and photographs furnished by H. K. Owens and A. V. Bouillon, Engineers, Empire Building, Seattle, Wash.

Headworks

Impounding Dam—The impounding dam is approximately 300 ft. long with a crest elevation of 445 ft. and a gate-sill elevation of 416 ft. The gateways, together with spillways aggregating 100 ft. length, give a flood-

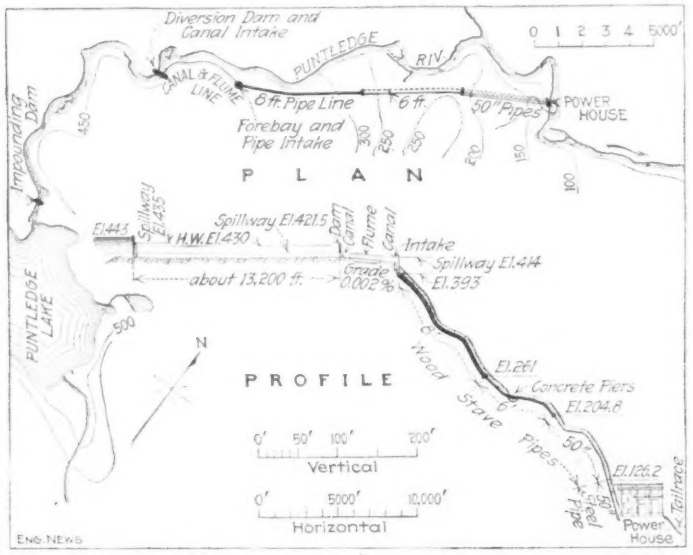


Fig. 2. Map, Plan and Profile of Puntledge Hydro-Electric Project

discharge capacity of 10,000 sec.-ft., which is in excess of the highest recorded outflow from the watershed. In general type this structure is a buttressed wall of concrete partly reinforced, the design of which may be seen from Fig. 1. A special feature is a log sluice (required by Government regulations) which was secured by omitting the wall in one dam panel and substituting therefor suitable stop logs readily removable one at a time to obtain the necessary depth for the passage of logs at any stage of water level. The storage of water and its flow over the spillways are controlled by wooden needles which close the spillway wickets and are so made and installed as to be readily removed for relief in time of flood. These needles are of 3x4-in. lumber 12 ft. long, dressed to $2\frac{5}{8}$x$3\frac{5}{8}$ in. and fitted with forged iron ends for protection and handling. There are six gateways, each 5x6 ft. controlled by steel butterfly gates with vertical axes. The gates are stepped in bearings set in the sill; the spindle extends to the gallery at the top of dam and through a cast-iron pedestal frame which carries the weight of the gate and spindle and holds a worm-operating gear fitted with double hand cranks. The gates fit loosely into the gateways, it being not intended to obtain water-tightness; their vertical position is adjustable overhead at the thrust bearing.

The dam is built on solid rock; the concrete is composed of ordinary gravel aggregates in a 1:2½:5 mix, with approximately 10% of hydrated lime added to the cement as a neutral filler to obtain water-tightness. To insure against uplift of the structure from pressure in horizontal seams which might exist in the underlying rock a number of weep holes were drilled in the rock to a depth considered sufficient and were fitted with open pipes leading up and out to the downstream face of the dam.

Diversion Dam—This dam is also built of concrete and partly reinforced at the intake end; the spillway is 100 ft. long. The Government regulations required a fish ladder at this dam and this was built in one of the concrete abutments (Fig. 1) so as to be protected from damage in time of flood. There are two gateways in this dam each 6 ft. by 7 ft. wide; the gates are of steel plates riveted on frames of steel channels and are fitted with rollers to reduce friction in operation. Water-tightness is obtained by flexible diaphragm strips which bear upon the face of the gateway along the sides and top and by a cushion on the bottom which seats on a steel channel sill laid inverted in the concrete floor. The gateways are protected by sectional steel screens designed for convenient handling and upkeep. The lifting gears for the gates are of the rising-stem screw type, the stems being 2½ in. in diameter with bevel-geared operating stands and hand cranks located on an overhead working platform.

Canal and Flume—This division of the work has alternating sections of canal and flume in which there are many sharp curves necessitated by the broken nature of the ground. The canal sections occur in solid rock, sand, gravel and clay—all being lined with concrete except some parts cut through impervious clay. The intermittent sections of canal are connected by a wooden flume built of staves laid on steel suspension rods carried by and between side girders laid on bents placed 16 ft. center to center.

Fig. 3. Semicircular Flume on Bents and Piles

The flume is approximately semi-circular in shape, 12 ft. wide and 7 ft. deep. The staves are of 3x6-in. lumber dressed to $2\frac{9}{16}$x$5\frac{7}{16}$ in.; the suspension rods are ¾ in. in diameter, are spaced 24 in. on centers, and are ad-

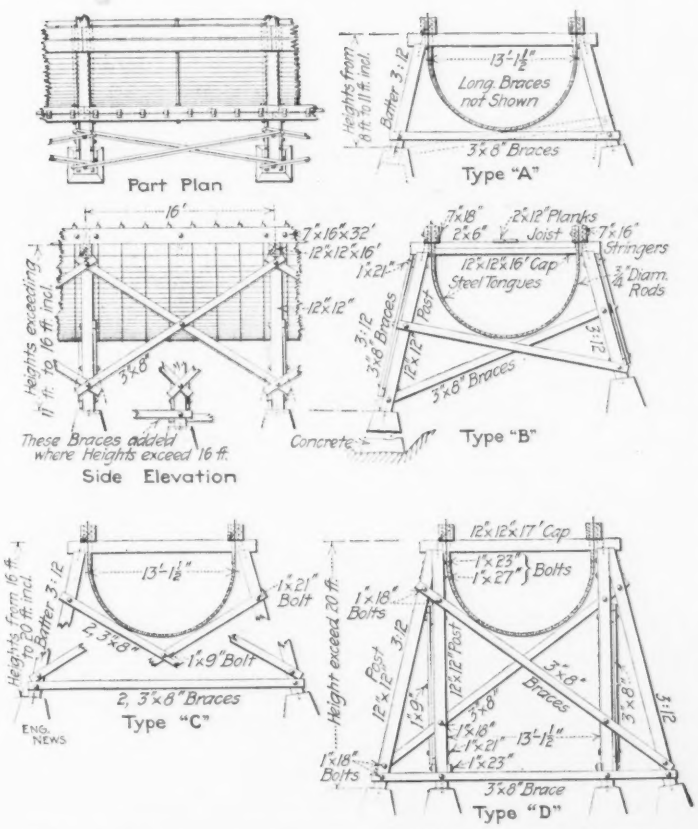


FIG. 4. DESIGNS OF BENTS FOR WOOD-STAVE FLUME

justable over each girder by screw ends with nuts over specially designed washers. The girders are built up of double fir timbers, 8x16 in., with space between, fixed by separators, for passing the suspension rods through. The flume bents are built on concrete piers except across a swamp where the girders are carried directly on piles driven to solid bottom. This design was found to be economical and well adapted to rapid erection.

The canal and flume line terminates with a short section of reinforced-concrete canal, the shape of which is gradually changed to secure smooth entrance into the forebay structure. Before reaching the forebay, one side of the canal is formed into a spillway of capacity sufficient to carry away the entire flow to this point (Fig. 5). A rotary balanced steel gate, "Taintor" type, is installed at the canal entrance to the forebay to regulate or to shut off the supply from the canal and flume line. (This is only the second plant in America recorded as having this style of headgates, the first being the Au Sable River development in Michigan, see ENGINEERING NEWS, May 16, 1912.) This gate is 12 ft. wide and approximately 10 ft. high; in structure it consists of two main arms made of steel channels gusseted to the steel-channel gate frame and covered by steel plates. The gate is balanced by a cast-iron beam of heavy section fitted as a spreader at the end of the supporting arms which extend back from the trunnion bearings within the

FIG. 6. TAINTOR HEAD GATES AT THE PUNTLEDGE PLANT

FIG. 5. REINFORCED-CONCRETE FOREBAY AND APPROACH CANAL

Wood was adopted for flume and supporting structures because of the general adaptability of the material to the local requirements. The design has been so made that any part of the support can be renewed without interrupting the operation of the plant. The flume itself except for staves near the flow line is under practically the same conditions as submerged wood and therefore of indefinite life; no trouble is expected in the maintenance of the flume proper since a large part of it can be replaced without shutting down entirely.

forebay for this purpose. The gate is operated by hand gear high up at one side of the canal and working through a chain and pinion shaft engaging circular racks secured to the plated face of the gate. Water-tightness of this gate is obtained by flexible diaphragm strips which are fastened to the side edges of the gate and slide in grooves formed in the side walls of the canal to match the shape of the gate, the seats for the strips being brass bars laid in the grooves and secured in the concrete. The bottom of the gate is fitted with a soft cushion which

seats on the concrete floor of the canal and, while it was not intended to have this gate absolutely water-tight, it is found to be practically tight in actual service. It works well in other particulars.

FOREBAY—This name generally implies a reservoir of some considerable capacity intended to provide for constancy of supply to the penstock system but the corresponding structure in this case was designed as a suitable form of intake for the penstock rather than as a reservoir, since the canal and flume line are depended upon to provide the requisite forebay capacity. Essentially, the forebay structure is a vertical reinforced-concrete cylinder with the canal entrance on one side and the pipe intake opposite. The basin formed by this structure is divided into two sections, which are separated by a weir wall and screens. That section into which the canal discharges forms a sedimentation basin with its floor sloping to a sluice-gate blowoff; the other section forms the intake of the penstock pipe and is completely inclosed.

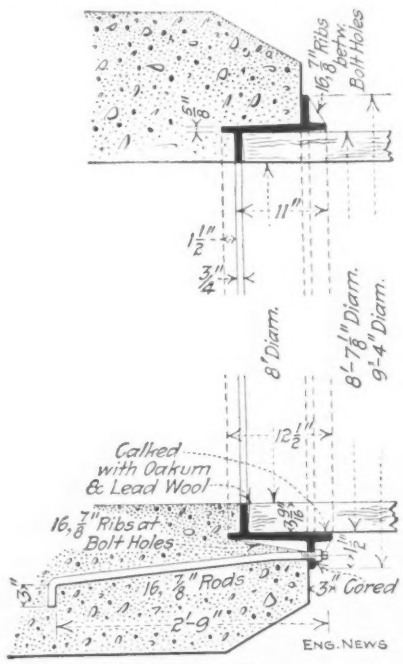


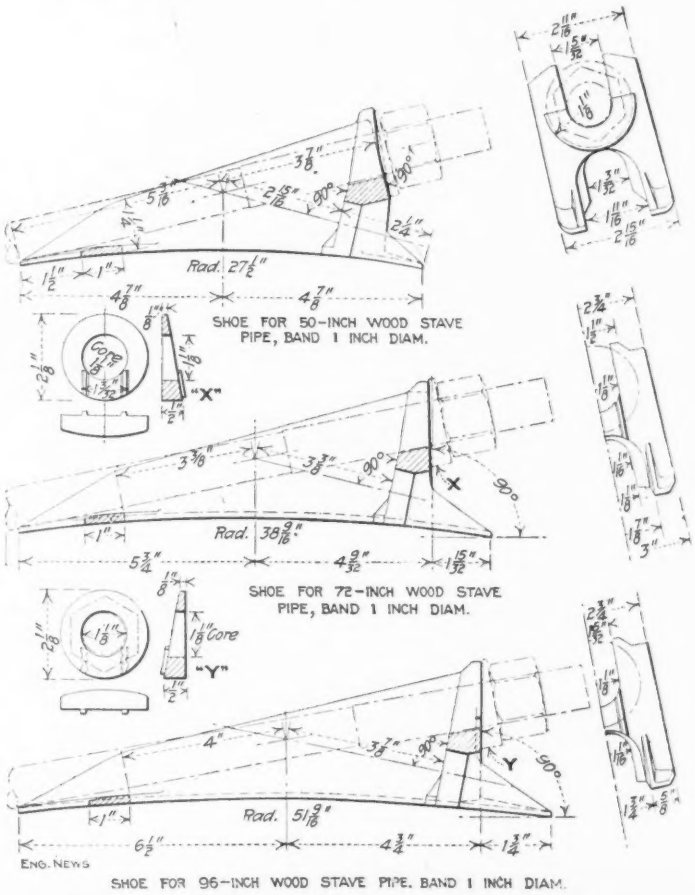
FIG. 7. FOREBAY CONNECTION WITH WOOD-STAVE PIPE

The concrete in this structure is composed of the same aggregates as already specified for the impounding dam, including the same proportion (10%) of hydrated lime and it is found to be water-tight in service. The outlet connection of the 8-ft. pipe is funnel shaped, 12 ft. in diameter at the inner end and tapering to 8 ft. in diameter in 7 ft. length. For connection with the wood-stave pipe, a cast-iron ring was laid and anchored in the concrete at the mouth of the outlet, the cross-section of which (Fig. 7) forms a rabbet for the pipe staves with tapering clearances which provide calking spaces all around the pipe outside and at the end of the staves inside. The calking materials used are oakum and lead wool and the joint thus obtained is very satisfactory. Similar construction was employed for all transitions from wood-stave pipe.

PENSTOCK

STAVE PIPES AND SHOES—The staves in the 8-ft. pipe are made of 4x6-in. lumber, finished to a thickness of $3\frac{9}{16}$ in. and an outside width of $5\frac{9}{16}$ in., there being 58 staves around the circumference. The staves for the 6-ft. and 50-in. pipes are made of 3x6-in. lumber, dressed down to $2\frac{9}{16}$- and $2\frac{1}{2}$-in. thickness, respectively, and maximum widths of $5\frac{5}{8}$ and $5\frac{9}{16}$ in.; 43 staves form the full circle of the larger pipe and 31 staves that of the latter. These staves are all made of clear Douglas fir. The stave ends are grooved for a steel tongue $\frac{1}{8}$-in. thick and 2 in. wide to make the butt joints tight. The bands for all pipes are uniformly 1 in. in diameter; the maximum spacing is 12 in., center to center, but this occurs at the upper end of the 8-ft. pipe only; the minimum spacing is 2 in. center to center which is as close as bands and shoes of the size adopted can be laid. Where the pressure required closer spacing the size of the pipe was changed and this determined the lengths of pipes of the several sizes noted in the brief description first given of the penstock system.

The bands are made in two sections, one having threaded and the other button-head ends. The threads are rolled on. Each band has two coupling shoes of malleable iron. A great deal of study was given to the design of the shoes or couplings for pipe bands; a number of standard shoes offered by manufacturers were examined and some were tested with a view to their adoption. But none of the ready-made ones offered were found satisfactory, it being apparent that the larger sizes offered were mere expansions of original designs for comparatively small sizes without adequate increase in dimensions to balance the increases in sizes of either pipes or bands. Therefore, the shoes used on the various pipes of this system were designed especially to meet the actual requirements. In testing some of the ready-made shoes offered, it was found that the threaded end of the band with nut and washer would easily slip off when under stress even before any noticeable deformation of the shoe had taken place and some of them had such a narrow margin of safety in this particular that they would not be safe to use on pipes of any considerable size. Careful attention was therefore given to this feature. The designs for the larger pipes vary somewhat from that adopted for the smallest size. On the shoes for the 50-in. pipe an inward slope as well as a dish is provided in the face of the lugs, securely to hold the band end; this was considered safe for pipe of this size and band curvature, but for the pipes of the larger sizes, the curvature of the


SHOE FOR 50-INCH WOOD STAVE PIPE, BAND 1 INCH DIAM.
"X"
SHOE FOR 72-INCH WOOD STAVE PIPE, BAND 1 INCH DIAM.
"Y"
Rad. 27 1/2"
Rad. 38 9/16"
Rad. 51 9/16"
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SHOE FOR 96-INCH WOOD STAVE PIPE, BAND 1 INCH DIAM.

FIG. 8. SHOES FOR WOOD-STAVE PIPE BANDS

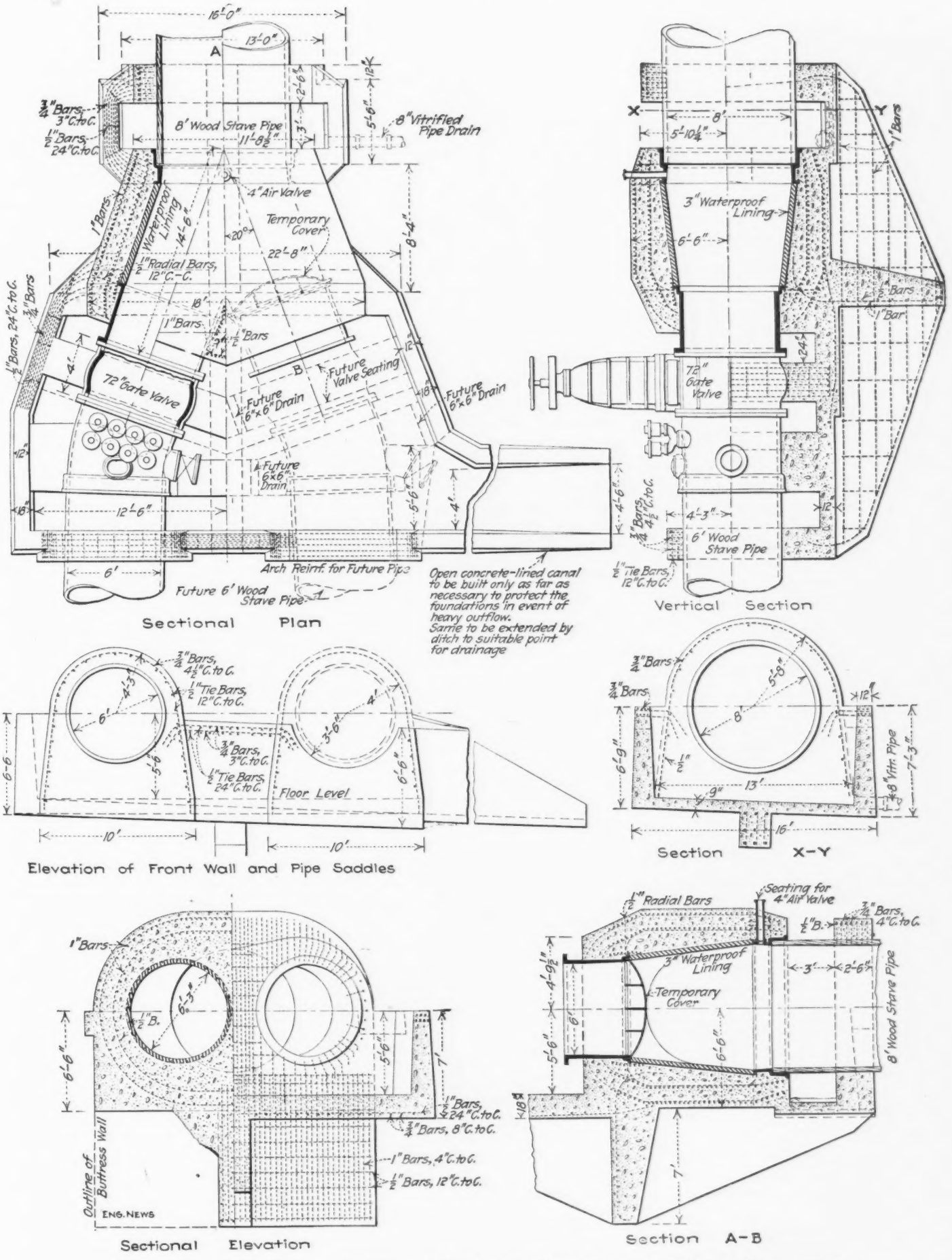

FIG. 9. A 96x72x72-IN. REINFORCED-CONCRETE HIGH-PRESSURE Y-PIPE CONNECTION

bands being less and the tangent end longer, it was deemed necessary to provide more pitch in the face of the lugs and to use tapered cast washers which lock the ends in place. The castings are of malleable iron (30,000 to 40,000 lb. per sq.in. tensile strength, elongation 2% in 4 in., any part capable of being bent or twisted 90° by hand hammering). A few shoes of each size were made from preliminary patterns and tested. Guided by

the results of these tests, the patterns were modified slightly as deemed advisable until shoes were obtained of strength equivalent to the average elastic limit of the bands, the weights of the respective shoes being held at the same time to the minimum commensurate with their strength as thus determined.

Manholes are fitted to the wood-stave pipes at intervals and particularly at summits where they are provided with automatic air valves for outlet of air during service and for inlet when the pipes are to be emptied. The manholes have cast-iron saddles with lugs designed to receive the band heads but the extreme side bands pass over the saddles, thus acting to clamp them on the pipe. The castings are not otherwise secured to the pipe. The manholes are closed with cast-steel covers bolted on the facings of the saddles.

The stave pipes are laid in a shallow trench for practically their whole length; in one depression, for a distance of 820 ft. it was deemed more advantageous to hold the grade-line elevated and to place the pipe (the 6-ft. line) on concrete piers.

Y-Junctions—Several designs were considered for the structures forming the junctions between the pipes of the different sizes. The first was for structures built of steel plates riveted in alternative forms of Y's and cylindrical headers, but after considering the size of the structures, range and nature of the stresses introduced by attaching to them stop valves in the penstocks, the designs of riveted plates were set aside as unreliable; moreover, the difference in cost between that type of structure and the design finally adopted was in favor of the latter. A second design was studied with the idea that steel castings could be made more rigid than the riveted-steel structures and could easily be provided with suitable means for anchorage; but the cost of such structures, including the necessary foundations for support and anchorage, was excessive. The design finally adopted was one in which foundations and anchorage were most conveniently combined—reinforced concrete, a type of structure believed to be unusual for such high-pressure work. The junction between the 8-ft. pipe and the 6-ft. pipes was designed for a maximum internal pressure of 115 lb. per sq.in. and that between the 6-ft. and 50-in. pipes for 160 lb. per sq.in. The 8-ft. pipe connects directly with the first Y-structure and the joint is made to a cast-iron ring set in the concrete and forming a bell end for the wood pipe. Water-tightness at the joint is obtained by the means used where the same pipe leaves the forebay. All other pipe connections with these concrete structures are similarly made with flanged cast-iron sleeves set in the concrete to which gate valves are attached. These gate valves are to enable the isolation of any one of the connecting pipes and (ultimately) the operation of the plant with one or the other of the 6-ft. and any or all of the four 50-in. lines. This explains the reason for making the lower junction structure a chamber common to the two inlet and the four outlet pipes—providing a bypass here connecting all sections of the penstock system. As will be readily understood, the introduction of stop valves in the penstock complicated the design problems as forces are developed of a magnitude not encountered in open-way penstocks.

The branches from these junction structures leave at an angle to the axis of the pipe line, and the alignment of the stave pipe parallel to such axis is restored at a short distance below each respective structure by means of cast-iron pipe bends bolted to the valves and fitted with manholes, air valves and relief valves, the latter consisting of a flanged gate valve bolted to a facing on the side of the cast-iron bend with a bursting-plate cover bolted to the outlet. Each bursting plate consists of a cast-iron flange ring within which is a cast-iron plate turned to such size as to leave an annular space of about $\frac{1}{8}$ in. The inner edge of the ring and the outer edge of the plate are grooved, the cut being narrower in the edge of the plate than that in the ring. The annular space with the grooves is filled with lead calked water-tight, it being intended to shear off the tongue of lead formed by the groove in the plate and to release the latter in the event of unexpected excessive load. To accomplish this without undue friction, the edge of the plate is turned with a taper. The thickness of the inner tongue of lead ($\frac{3}{16}$ in. in both sizes of plates) was determined after tests made to ascertain the average shearing strength of the tongue under such conditions. Automatic air valves are fitted at these structures, both for escape and inlet.

Water-tightness of the concrete structures was obtained by building the walls proper to within 2 to 3 in. of the inner surface of rich portland-cement concrete composed of fine aggregates of maximum measured density. The proportions averaged 1:1:2, the gravel varying from pea size to 1 in. The inner thickness of 2 to 3 in. was made up of 1:1½ portland-cement mortar. The inner surface of this coating finally was covered with several coats of asphaltum applied hot.

In the chamber of the structure for the junction of the two 6-ft. penstocks with the four 50-in. penstocks, only one-half of which is being utilized for the partial plant now built, the side which is not connected up is separated from the other by a removable wooden bulkhead, provision for which was made in the structure by rabbets armored with steel shapes set in the concrete. This feature of the design was provided on both sides in order that similar isolation of one side or the other can be readily effected at any time in the future should such be necessary for any purpose. The anchorage of the concrete structures is secured by reinforced walls approximately 7 ft. deep, buttressed to the Y-structure, and to the apron which forms the foundations for the valves and heavy cast-iron connections, the design providing amply against the overturning moment as well as against slid ing. The apron referred to constitutes also the floor of a drainage basin for the relief valves, the outlet of which is an open ditch to lower ground with natural drainage to the river.

Lower End of Penstocks—Where the minimum spacing of bands is reached with four pipes (two at present), the type of construction is changed to steel pipes which are connected to the stave pipes by means of riveted-steel tapered sections joined with the wood-stave pipes by a bell end of such shape as to allow calking at the outer end of the steel section, as well as against the inner ends of the staves. This steel section has angle-bar anchoring rings riveted on and is set in a concrete anchoring block forming the base of a chamber giving access to a manhole fitted on this section. The steel pipe, which is of lockbar type, is riveted to the special steel section just described, each of these steel penstocks is 660 ft. long and their thickness varies from $\frac{3}{8}$ in. at the upper end to $\frac{7}{16}$ in. at the power house. The steel pipes are

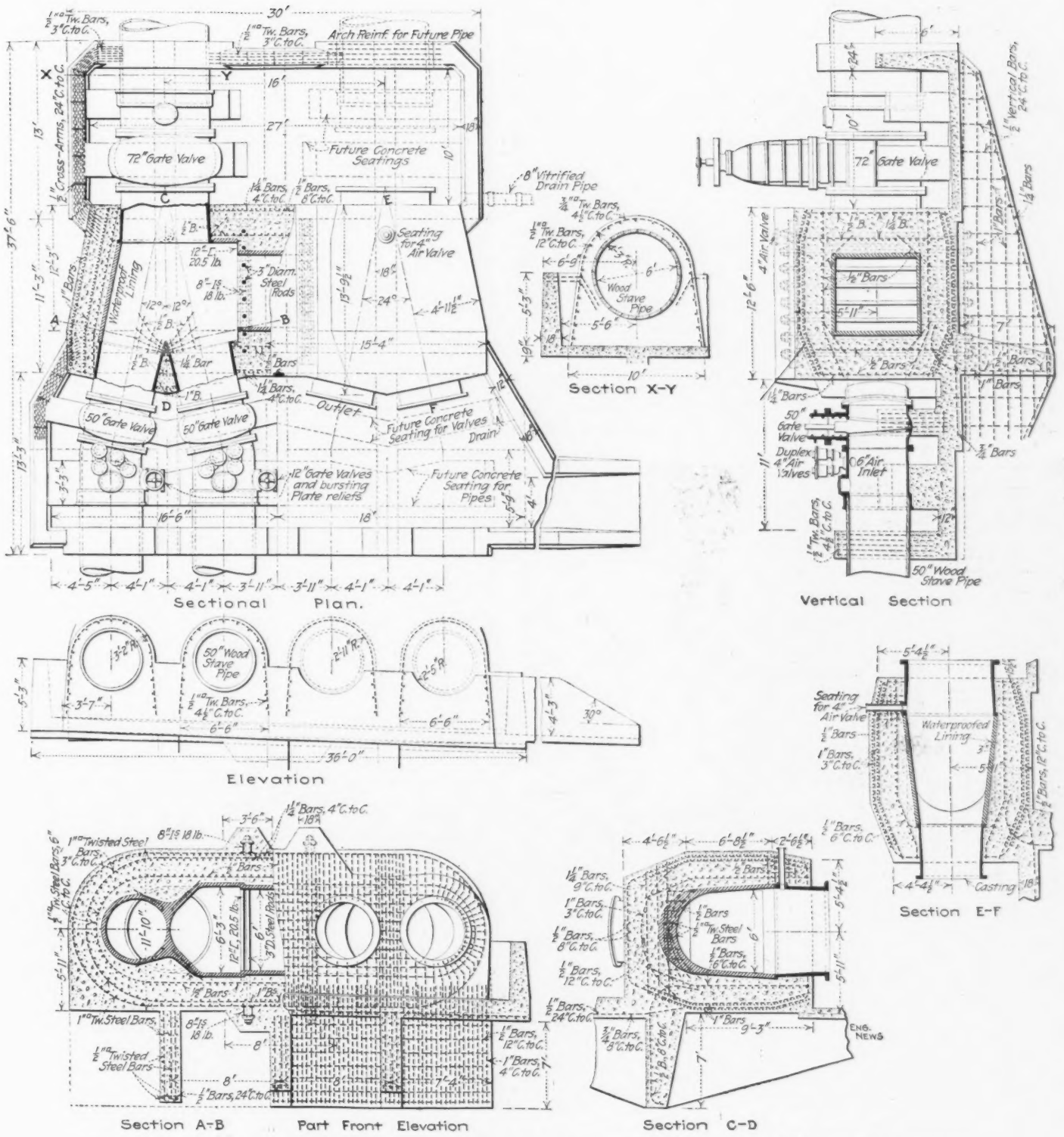

FIG. 10. A DOUBLE 72x50x50-IN. REINFORCED-CONCRETE HIGH-PRESSURE Y-PIPE CONNECTION

laid in trenches, much of which is in solid rock. At about the middle of their length there are expansion joints—steel castings with packed slip joints. Each joint is in a concrete chamber and the steel pipe is laid in tarred felt through the walls of this chamber so that it is free to slip. The lower ends of the steel penstocks are anchored near and at the power-house foundation and terminate within the building with a cast-iron closing piece connecting them to hydraulic shut-off valves installed at the respective turbines.

POWER HOUSE

BUILDING—The power house is built of reinforced concrete on a rocky site at the river's edge; only approximately one-half of the principal building contemplated has been erected for the accommodation of the present units, but the annex section of the building which contains the switching and other electrical apparatus and the wire outlets has been built complete. Provision has been made in the design for extension of the main body of the building to house the remaining units without disturbance to the operation of the present plant.

The annex section, which is three stories high and 18½x65½ ft. in floor dimensions, has the upper floors of concrete supported by I-beams. The roof of the entire building is built of concrete laid on ribbed-steel mesh plastered underneath. The roof framing of the annex section consists of 9-in., 21-lb. I-beam rafters and that of the main section of steel trusses placed 20 ft. center to center, supporting 9-in., 21-lb. I-beam purlins. The sides

of the building are of glass in large proportion. The main building is designed with crane girders on which a 40-ton traveling crane has been installed. These girders are of reinforced concrete with embedded runway rails. All of the concrete in the exterior of the building was made with 10% hydrated lime. The roofs are covered with felt; the roof drainage is run through the interior of the building to a central drain to guard against frost in the leaders.

SCHEME OF REGULATION—The static head is 350 ft., and the length of the penstock system being 13,700 ft., the head-length ratio of the pipe is about 1:40. The part played by such a high ratio, as an unfavorable element in the problem of regulation under varying power-load conditions, was fully realized; much study was given to the general development to obtain the arrangement most favorable to good regulation, but the ratio obtained was the best possible owing to naturally unfavorable topographical conditions. The forebay is located at the

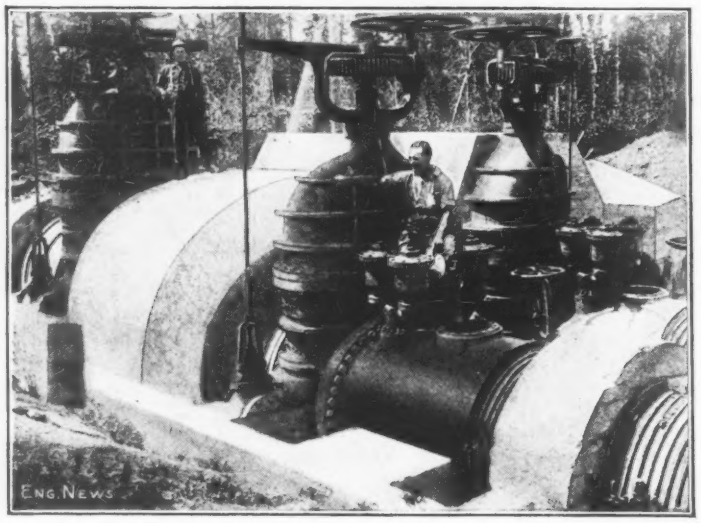

FIG. 11. THE 72x50x50-IN. Y-CONNECTION OF THE PUNTLEDGE PENSTOCK (HALF OF ULTIMATE EQUIPMENT SEEN)

nearest suitable point to the power house, the general slope increasing from this point gradually to the station site.

In a penstock system of such a high head-length ratio, it is difficult to obtain power regulation by means designed to conserve the water-supply but, inasmuch as there was no scantiness of supply and economy of water did not enter, the problem of regulation as presented was comparatively simple. The arrangement adopted, however, insures against sudden or high rises in pressure in the penstock system. Throttling of the turbine gates by the governor gear of each turbine operates a relief valve on its penstock which opens and closes with the turbine gates, thus permitting water to waste in approximate proportion to the load taken off and maintaining so nearly a uniform rate of flow in the penstock as to prevent the pressure rises due to governor throttling to exceed a nominal percentage of the pressure due to the active head. This relief-valve gear is adjustable to close in any desired length of time so that the water waste need be no more than sufficient to diminish the penstock flow at a proper safe rate. The general arrangement as designed includes, in addition to the governor-actuated relief valve, an independent direct-pressure relief valve which would open in the event of extraordinary rise in pressure caused for instance by any trouble occurring to the governor gear. In addition to the valves described, there is a safety relief—a bursting plate closing the end of a nozzle which terminates each penstock in the power house so that, in the event of accident to the governor gear and relief valves, any abnormal or dangerous rise in pressure in the penstocks would be prevented.

TURBINES—The turbines are of reaction type with governor control of multiple balanced gates at the inlet. A hydraulic shutoff valve is installed in each penstock in conjunction with the turbine. Each machine is direct connected to its generator. The specified rating of each turbine is 4700 hp. under the conditions to be obtained when the penstock system is completed and supplying four units at full power. For present purposes only two of these units are installed and inasmuch as the upper portion of the penstock system is constructed of the requisite capacity for four units, the available power of the two turbines now installed exceeds their rating to the extent of 28% for one turbine operating alone and 7½% when both are running at full gate.

The machines are placed with the shaft parallel with the longitudinal axis of the building. The floor space required for each unit is 32x50 ft. and the floor space of the ultimate power house as designed is 34x214 ft. The main building as far as constructed for the present is 34x117 ft.

ELECTRICAL PLANT—The alternating-current generators (3500-kw. 13,200-volt 500-r.p.m.) have the lower portion suspended from the foundation piers within the foundation pit. These machines are designed for a 25% continuous overload. Each machine has its exciter direct connected but the capacity of one exciter is sufficient for two machines when operating at 80% power factor.

The electrical conductors from the generator pits are laid in the concrete floor and foundations and the leads are accessible at numerous points in manholes and tunnels. The grouping of the leads from the switchboard and switching apparatus is effected in a central tunnel. The switchboard and control station are placed on an extension of the second floor of the annex, projecting as a gallery within the main portion of the building, from which the full interior of the power house proper is visible to the operator. The switching apparatus is located on the annex second floor and is contained in a series of reinforced-concrete cells. Six lightning arresters are located on the upper floor and from these the transmission lines pass out through the side of the building with the usual insulated wall entrances and attachments, which are protected by a 6-ft. awning extension of the roof.

It will be noted that there are no step-up transformers for the transmission lines. On account of the short runs no such apparatus was required, the longest line being under six miles. Most of the current is used at transmission-line voltage but step-down transformers are used in various places where the lower voltages are required.

The plant above described is now in operation and its performance is meeting all expectations. It should be noted that the storage and diversion works,, water conduit, forebay, wasteway and the upper third of the penstock system are completed for the full capacity of four units, while the lower two-thirds of the penstocks are completed only for supply to the two of these units now in operation. The cost as now constructed, figured on

the basis of the normal output capacity of the two units now installed, is less than $70 per hp. at the power-house switchboard; the corresponding cost will be reduced to less than $60 when the plant is completed and the output of four units is used. Considering the permanent character of the work throughout, the isolated location of the plant in relation to material and labor markets and the fact that a great deal of material and many appliances required for its construction had to be imported and were subject to heavy customs duties, these low costs are noteworthy.

The generators and electrical apparatus were manufactured and installed by the Canadian General Electric Co. The turbines with governor gear, the relief valves and the hydraulic penstock stop valves were furnished and installed by Escher, Wyss & Co., of Zurich, Switzerland.

The 50- and 72-in. gate valves in the penstocks and the air valves (Crispin type) were furnished by the Crane Co., of Chicago. The lockbar steel pipe was made by the East Jersey Pipe Co., of Paterson, N. J. The power-house and hydraulic-plant work was done under a general contract by Grant Smith & Co., of Seattle, Wash. Briefly, this contract embraced all of the work from the clearing of the land to and including the power house, with the exception only of the machinery and power-house apparatus. The work was begun in the late fall of 1911 and while no unusual difficulties were encountered in its execution, much delay was caused by extraordinary high water and inclement weather. The construction of the plant and installation of the machinery were supervised by the Canadian Collieries (Dunsmuir) Ltd., of which W. L. Coulson is manager and Joseph Hunter is chief engineer. They were represented on the work by L. Netland, resident engineer. The materials, fittings and structural parts purchased for the power house and hydraulic development were inspected and tested at the various places of manufacture by Robert W. Hunt & Co. under the general instructions of the owners and their consulting engineers. Plans and specifications for the work, including the detail working drawings, were furnished by the firm H. K. Owens—A. V. Bouillon, consulting civil and mechanical engineers, of Seattle.

The City-Manager Plan at Clarinda, Iowa

[*Contributed*]

Some months ago the City of Clarinda, Iowa, adopted a plan for administering city affairs under the direct supervision of a single individual called the city manager.

The Iowa law provides for a city council composed of a mayor and one councilman from each ward of the city, and two councilmen at large. As a first step in concentration the number of wards of this little city of about 4000 inhabitants was reduced to two, thus limiting the number of councilmen to four. At the same time the size of council committees was reduced from three members to one, and these only act as advisors to the city manager. The next step was to appoint one man outside the council to act as city manager. His duties were to be those of the former city clerk, the street commissioner, the water commissioner, the sewer superintendent, and the custodian of the cemetery.

Such a man was found in the person of T. A. Wilson, a resident of Clarinda, young, industrious, energetic, with previous business experience. His office is always open to the public and all complaints received by him are registered and promptly investigated.

It has been observed that the city manager is respected by the city employees, and that they know he is liable to inspect them and their work at any moment. Several changes have been made in employees where it was evident that they were not doing their best. As a result a force of trustworthy men has been obtained.

The city employees are used interchangeably in all departments, whereas heretofore one set of employees has worked on one class of work only. Now a few men of tested worth do the work of all departments, and they are steadily employed, which is to the advantage of the city and the individual.

At the present writing, the affairs of the city are being efficiently managed—far better than under the old system as observed in other cities of its class. The several miles of street pavements and dirt roads are in far better condition than they are to be found in other cities even larger than Clarinda.

A systematic method of keeping account of the expenses of the different departments is being worked out. The city manager carefully audits all claims against the city. He is in position to do this carefully, and to the great advantage of the city over the old method where it was often difficult to trace the origin of a claim. Under the present system, practically all claims against the city are incurred on the order of the city manager, hence he is familiar with them.

Apparently the city-manager plan can be operated at less cost to the city than the commission form of government with salaried commissioners. In a small city, the salaries of commissioners are so small that they cannot afford to give their whole time to the work of the city, and if not, then it is better not to have the commissioners on a salary.

The city manager of Clarinda receives a salary of $1500 per year, and if he is retained for a few years he will, by reason of his experience in municipal work, be worth considerable more money to his city.

On the whole the city-manager plan seems to be working well in this little city. Doubtless if there were men especially fitted for this kind of work, and there are a good many, they would be worth much to the smaller towns, at least, and, in the opinion of the writer, to the larger ones as well.

It is to be hoped that the city-manager plan will be given long enough trial to prove its worth, and that it will not fall to the caprice of the ever-changing public mind before that time.

Roads Funds from the National Forests—The federal forest law requires that 10% of the gross receipts from the national forests shall be spent in the states in which the forests are situated. This money is expended for road improvement under direct control of the Secretary of Agriculture.

The amount appropriated under this act, based on the receipts of the national forests for the fiscal year ending June 30, 1913, is $234,638.68. From the 1912 receipts for this 10% road item, there is an additional $134,831.10, which is still available.

In administering the 10% road fund, forest officers charged with the actual plans and expenditures in the neighborhood of their forests have, in almost all cases, secured an equal or a larger coöperative fund from state authorities for the building of certain pieces of road. [U. S. Forest Notes.]

Grade Reduction and Doubletracking on the Nashville, Chattanooga & St. Louis Ry.

The main line of the Nashville, Chattanooga & St. Louis Ry. running west from Chattanooga, Tenn. (to Nashville) has a very heavy traffic for the first stretch of 38 miles, as it is used also by the Southern Ry. as far as Stevenson* (39 miles) and by the Alabama Grea Southern Ry. as far as Wauhatchie (6 miles). This part of the line carries about 70 freight trains and 28 passenger trains per 24 hr. In order to improve the facilities for handling this traffic the line is being double-tracked between Chattanooga and Stevenson, while grade and curve reductions are being made at several points.

All grading is done by contract. The concrete bridges and culverts and other structures are built by company forces, the railway maintaining its own concreting gangs. There is only one steel structure, the Running Water Viaduct; the concrete work for this is done by the company, while the steel work is done by contract. The tracklaying and shifting is done by company force. The work is under the general direction of Hunter McDonald, Chief Engineer, and C. H. Johnson, Engineer of Construction. R. M. Milam, Assistant Engineer, is in

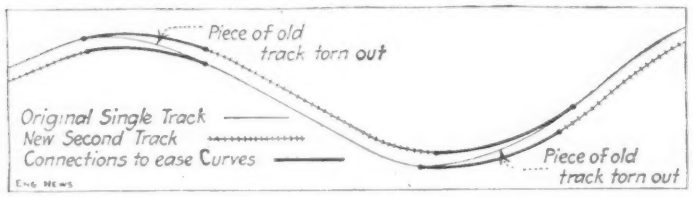
Piece of old track torn out
Original Single Track
New Second Track
Connections to ease Curves
Piece of old track torn out
ENG. NEWS

FIG. 1. METHOD OF EASING CURVATURE IN BUILDING SECOND TRACK: N., C. & ST. L. RY.

resident charge of all the work between Chattanooga and Stevenson.

DOUBLE TRACKING AND TRACK WORK

The double tracking has extended over about three years, being done partly in small sections by building and connecting passing tracks to form continuous stretches of double track. In double tracking where there are numerous curves, advantage has been taken of the opportunity to improve the alignment by putting the new track on opposite sides of the original track at different points. This involved a good deal of trouble in adjusting the superelevation to the new conditions, and great care was necessary also to insure keeping the track connected up so as to avoid interruptions to traffic. The two adjacent stretches of second track were completed as nearly as possible to the point at which they would intersect the single track. Then at some convenient time, with a good interval between trains, the single track was cut and its ends thrown over and lined up with the new track, as shown in the sketch plan, Fig. 1.

The width at subgrade is 33 ft. on all new work and double tracking. On the new roadbed a heavy bed of cinders is used for ballasting, as this is more easily surfaced during the inevitable settlement of the fills, and forms eventually a good sub-ballast between the roadbed and the permanent stone ballast. The new track is laid with 80-lb. and 85-lb. rails on oak ties, the ties being obtained mainly from along the Centerville and Jasper branches, and costing from 40 to 50c. each. No treated ties are used, except on bridges, where creosoted ties are standard.

On the double tracking, the ties and rails are unloaded by hand from work trains on the present track. On the new diversion line, the ties and rails will be distributed upon the roadbed by hand and push-cars.

South of Bridgeport the line crosses two arms of the Tennessee River, the bridge over the main channel having a drawspan. This stretch of line, consisting of timber trestle and steel spans, will not be double-tracked, but will be equipped with automatic block signals and operated as an isolated block section, to facilitate and protect the handling of traffic. Automatic block signals may be extended later on other parts of the line.

CHATTANOOGA TO SHELLMOUND

The new double track commences at Cravens, about two miles out of Chattanooga, beyond the terminals and yard limits. It continues mainly on the old right-of-way as far as Shellmound (22 mi.), with few deviations from the original location, and with few changes in grade.

GRADE REDUCTION AT CARPENTER

For about three miles near Carpenter the grade has been improved materially, an irregular profile with maximum grades of 1.1% being reduced to a more favorable profile with maximum grades of 0.5%. On the new roadbed the tracks have been laid and shifted in the manner already described, easing the curves, and connecting up passing tracks to form parts of the new main track.

In widening and lowering the cuts, the work was done in two stages. The original cut was first widened and cut a little below the original grade, and a temporary main track laid. Then the steam shovel excavated the original roadbed to the new grade, giving a width sufficient for double track.

In raising and enlarging the fills, the work was done in five stages. The fill was first widened (1) on one side to the old roadbed level; (2) then it was raised until the toe of its inner slope reached the main track. The track was then shifted to this new bank and the old fill widened (3) on the opposite side, and filling continued (4) until the inner slope reached the temporary track. This brought the new bank to the required elevation, and the main track was laid upno it, after which the bank was widened to the finished width (5) by side dumping. This arrangement of the work is shown by the profile and the cross-sections in Fig. 2.

BRIDGEPORT-BOLIVAR CUTOFF

Between Bridgeport and Bolivar there was originally a long grade of 1% against westbound traffic and this has been eliminated by the construction of a double-track diversion line between these points. The maximum grade is 0.5%, compensated to 0.4% on the two main curves, and this grade will be extended along the present line almost into the Bridgeport station. The distance is about the same as on the old line (5 miles), but the curvature is reduced materially. About half a mile from Bridgeport the new line swings away from the old one by a curve of

*It is of interest to note that a few years ago the Southern Ry. decided to build its own line between Chattanooga and Stevenson, involving a tunnel some 3800 ft. long under Lookout Mountain. This tunnel is double-track, and was completed at a cost of nearly $1,000,000, but after the death of Mr. Spencer, President of the Southern Ry., (in 1906) the project was abandoned.

4°, beyond which is a long curve of 2°. After this there is a tangent of about 3½ miles to an easy curve of 2°, which runs into the old location at Bolivar. Fig. 3 shows the plan and profile of the cutoff line.

At the east end of the diversion there is a long and heavy cut (nearly 200,000 cu.yd.), extending almost continuously for about 7000 ft. and broken only by a few small fills. In this is the summit, with a long vertical curve. Beyond this cut there are some alternating cuts and fills, for about 10,000 ft. These are followed by a fill 6000 ft. long across swampy ground, the fill being about 15 ft. high and aggregating 155,000 yd. In this fill is a concrete slab bridge with three spans of 31½ ft., crossing Widows Creek.

The heavy cut was made with a 70-ton steam shovel having a 3½-yd. bucket. The material was a compact and flinty chert, which could not be handled without blasting, and was very hard on the drills and shovel teeth. The material will stand with a nearly vertical face. The blast holes were put down with a well drill. The shovel loaded the material into standard-gage 12-yd. side-dump cars, the loaded trains being pushed to the fills by locomotives.

The slope of the ground was too steep to allow of operating a construction track across it, and as it was found impossible to make a preliminary cut with plows and scrapers, the shovel (starting at the Bridgeport end) made a first through cut on a grade of about 5%, the cut being about 10 ft. deep and 20 ft. wide, and the spoil being deposited on the surface at either side. The shovel then worked back from the west end, widening and deepening the cut. As the depth was such as to necessitate working at two levels, the shovel had then to make successive cuts, working east and west alternately, and finishing to a sub-grade width of 40 ft. This will allow for slips, the standard width of roadbed for both cuts and fills being 33 ft.

The material from the heavy cuts was dumped mainly in the long fill at the west end of the line, a temporary trestle of round timbers being built for this purpose. The cars were dumped (by hand) while standing on the fill, however, and only the empty cars ran out on the trestle. For the smaller cuts, wheeled scrapers were used.

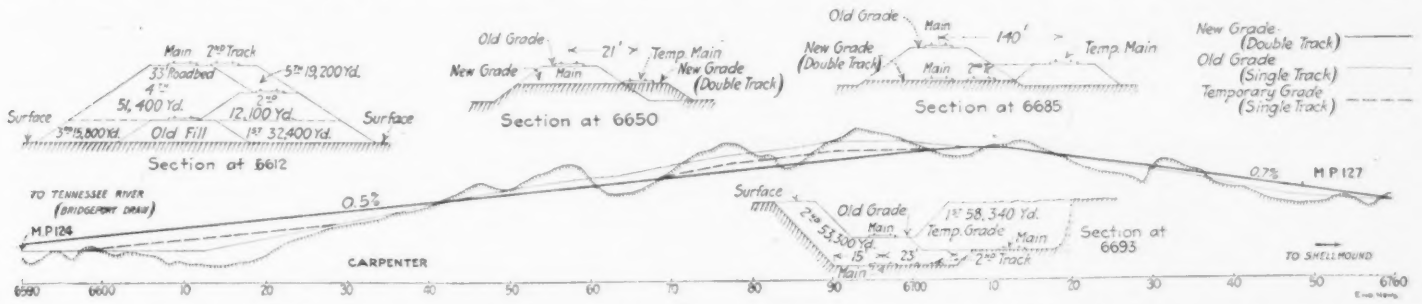

FIG. 2. PROFILE AND CROSS-SECTIONS SHOWING METHOD OF REDUCING GRADE AND WIDENING ROADBED ON AN EXISTING LOCATION

GRADE REDUCTION NEAR STEVENSON

East of Stevenson there was a long grade of 1.1% against southbound traffic, but for a distance of two miles this has been reduced to 0.3% in connection with the double tracking. This work included lowering the grade about 12 ft. through two summit cuts and raising it about 10 ft. in a long sag. This was steam-shovel work, mainly in red clay and shale and the material was handled by standard-gage dump cars and locomotives. The main summit on this part of the line remains unaltered as it occurs in a single-track tunnel 2200 ft. long under Cumberland Mountain, with approach grades of 2.5%. Plans have been considered for building a second single-track tunnel at the same or a lower grade, and also for building a new double-track tunnel at a lower grade, but nothing has yet been decided in regard to this.

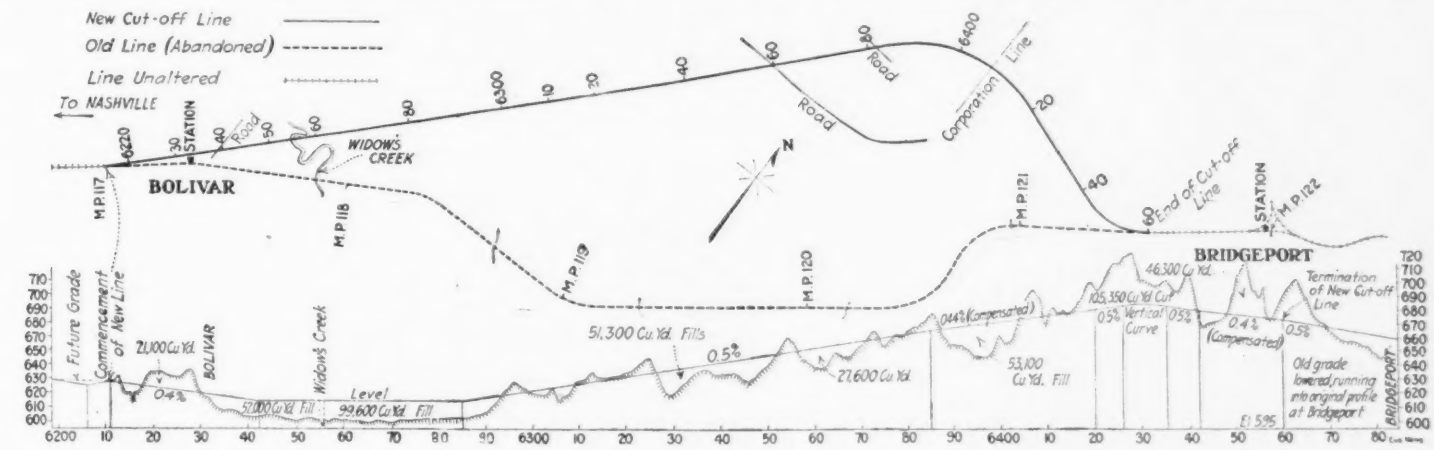

FIG. 3. PLAN AND PROFILE OF BOLIVAR-BRIDGEPORT CUTOFF LINE; NASHVILLE, CHATTANOOGA & ST. LOUIS RY.

SLIDES

At various points on the new work there has been trouble from slides. This is particularly the case near Raccoon Mountain, where the material is of a peculiarly broken and shattered character, and when once started

seems to continue moving almost indefinitely. There are strata of soapstone clay and shale lying on limestone ledges, and covered by boulders of sandstone and limestone that have broken from the upper levels of the mountain.

About ten miles from Chattanooga the line is in side-hill work around the base of this mountain, and a cut just beyond Hooker (10 mi.) gave continual trouble after the line was first built in 1852. To check the movement and avoid the necessity of frequent removal of sliding material dry masonry walls were built on each side of the cut, these being founded on solid rock. The loose material continued to slide over the wall on the upper side of the cut, however, and in 1858 a masonry tunnel about 300 ft. long was built in the cut and backfilled, so that the slides might continue without affecting the railway. The tunnel is of oval section and rather small for modern clearance limits.

In double-tracking, it was decided to swing the new line outside of this tunnel and to have it in open cut, thus improving the alignment. In constructing this work in 1911 the slides were frequent, and the excavation was about 120,000 yd. instead of 80,000 yd. as estimated. However, the excavation was continued until conditions became stable, and since then there has been very little trouble. Some movement has occurred at the west end, but has been checked by driving rows of piles.

The new cut exposed the south side of the tunnel, and as it was desired to maintain the tunnel line for possible use in the case of emergency, the exposed side of the masonry has been reinforced by concrete buttresses about 30 ft. apart, to resist the pressure from the hill on the other side.

At Whiteside (14 mi.) the line again cuts across the slope of a spur of the mountain, and is partly on a hillside fill. Here the whole hillside has been in motion. Fortunately, the country is unsettled, so no great damage has been done, but some houses have been shifted bodily out of position or even destroyed. At one time the track had to be watched constantly, and a gang of men kept on hand to maintain the track in line and surface, as at any time it was liable to shift to such an extent as to endanger traffic. Material originally on the upper side of the track gradually passed under the track and forced the lower side of the fill further down the hillside.

The material slides whether wet or dry, but the trouble is aggravated by rains and by water from occasional springs, which serve to lubricate or soften a clay substratum. Tile drains were out of the question, as they would be very soon dislocated and broken. Mr. Milam proposed to put concrete conduits up the hillside, on lines of marked waterflow through the material, but this was considered to be too costly. As a cheap alternative, however, he cut trenches along these lines and filled them with loose rock in large pieces, forming French drains. There has been practically no movement since these drains were completed.

GROUTING—Near Ladds, where the line follows around the bluffs along the Tennessee River, slides have caused further trouble, and widening the bank with slag did not prove effective as the ground was not stable and therefore did not give a permanent support or footing for the new material. The plan adopted to stop the sliding was to consolidate the loose ground by grouting it with cement.

The grouting was done through a 4-in. pipe having one end tapered down to 1-in. diameter and having a number of 1-in. holes drilled in it. This was driven by hand through the slag and into the underlying material, additional sections of pipe being added as required and fitted with a driving cap. The penetration was usually 15 to 20 ft. from the surface. When the pipe was driven as far as desired, the cap was replaced with a 45° elbow, and additional lengths of pipe screwed on to give a total head of about 20 to 50 ft. (at different points). The grout was a 1 to 2 mixture, made very thin and mixed by hand. It was poured into a hopper at the head of the pipe, and the pipe was pulled up gradually as the pouring proceeded, so as to grout almost to the surface. This has proved entirely successful in preventing further movement.

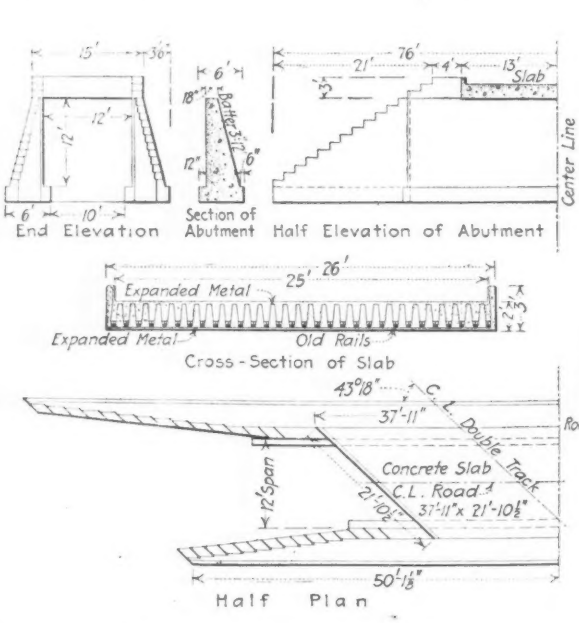

FIG. 4. REINFORCED-CONCRETE BRIDGE OVER PUBLIC HIGHWAY; NASHVILLE, CHATTANOOGA & ST. LOUIS RY.

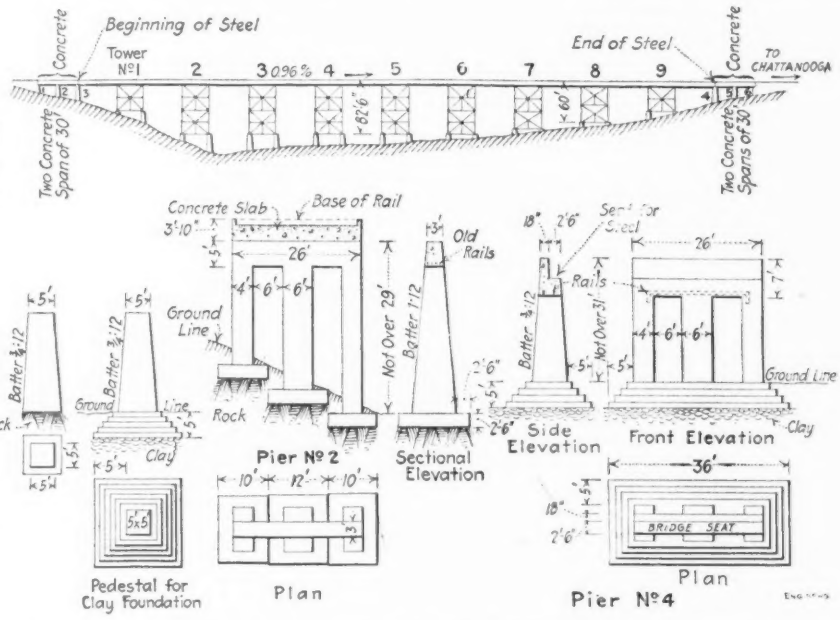

FIG. 5. RUNNING WATER VIADUCT; NASHVILLE, CHATTANOOGA & ST. LOUIS RY.

Slides and their prevention are matters of general interest to engineers on railway and other work, and in connection with the above description we may refer to the difficult work of checking a slide in a deep side-hill cut near Cincinnati, described in ENGINEERING NEWS of April 30, 1908. We may refer also to a proposed method of grouting slides so as to form underground retaining walls, described in our issue of June 5, 1913.

STRUCTURES

Nearly all bridges are of concrete, of the slab type. The main reinforcement consists of old 52- and 58-lb. rails, of which the company has considerable quantities, and which it is found economical to utilize in this way. In the bottom of the slab is a layer of flat sheets of expanded metal, 3x8-in. mesh. Above this are expanded metal sheets bent into narrow deep troughs or loops, as shown in Fig. 4, with an inverted rail in the bottom of each trough, the spacing of the rails varying from 9 to 12 in. The depth of slab varies, of course, with the span. The standard width is 26 ft. over all, including a 6-in. curb wall 12 in. high, on each side, to retain the ballast. The concrete is a 1:2:4 mixture, using crushed stone.

In the Widows Creek bridge, mentioned above, there are three spans 34 ft. c. to c. of piers, the slabs being 33 in. thick. The piers and abutments have plain footings on piles.

Subways or bridges at road crossings are 10 to 16 ft. in clear width, and in many cases are on a considerable skew (Fig. 4). Road crossings at grade are eliminated whenever possible, and are carried under the railway in most cases. Those over the railway have concrete-slab bridges of lighter construction.

Concrete-box culverts are used for sizes of 8x8 in. and over. Pipe culverts up to 6-in. diameter are used, but are entirely incased in concrete, so that there is no liability of the joints separating. Concrete portals are used also on these pipe culverts.

RUNNING WATER VIADUCT

Near Whiteside, there is a short diversion or cutoff which eliminates a number of curves and an old single-track steel viaduct which had the disadvantageous feature of a curve at one end. The cutoff runs straight across the valley of the Running Water Creek, and has a double-track steel viaduct 1200 ft. long with 40-ft. tower spans and 50 ft. intermediate spans. The maximum height is about 125 ft. The viaduct is shown in Fig. 5.

At each end of the steel structure is a concrete approach consisting of two 30-ft. concrete-slab spans on two piers and a back pier or abutment. The piers (Nos. 2, 3, 4 and 5) are not solid, but have each two rectangular openings to reduce the weight. The end or abutment piers (Nos. 1 and 6); however, are solid. There are no wing walls to the abutments, in view of possible movements of the approach fill on the side-hill ground. The slab spans are 34 in. thick, of similar construction to the bridge floors described above. A creosoted timber floor will be built on the steel spans and the entire deck covered with stone ballast.

The concrete pedestals and abutment piers are of 1:3:6 concrete, while the slabs are of 1:2:4 concrete. The sides of the valley are steep, and a concrete-mixing plant is installed on one side, a little below the rail level, so as to receive material by gravity. The concrete is dumped into cars running on an incline operated by cables. Concrete is delivered to the opposite side of the valley by small narrow-gage cars, handled by a hoisting engine and cable. The concrete is delivered to the forms by hand, either in wheelbarrows or wheeled buckets.

The concrete work for the Running Water Viaduct is done by contract, but all other concrete construction is done by the railway company's special concreting gangs.

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Work in Nonferrous Metals at the Bureau of Standards*

USE OF NONFERROUS METALS FOR STANDARDS—The most fundamental and universal of all standards of measure, that of length, is defined and concretely represented by a bar of platinum-iridium alloy, of which are made the prototype meter and its copies in the possession of the various governments. The older length-standards were usually made of brass, as are the more common standard copies of the meter and yard today. Our standard of mass is also of this same platinum-iridium alloy, and here again brass is generally used for making copies. But it is not merely for our fundamental standards of length, mass and time that we may be said to be indebted to the non-ferrous metals and alloys. They permeate the whole realm of standards from electricity to heat and radio-activity. Thus the primary standard of electrical resistance is the ohm of mercury, and the working standards are coils of manganin wire. Our most exact thermometers are constructed of platinum [resistance], and the bulb of the gas thermometers used as the basis for defining temperatures is usually made of one of the alloys of platinum with rhodium or iridium. Again, the best thermocouples are constructed of the noble metals and their alloys.

Even in the restricted fields above mentioned, progress is constantly being made. To cite a single example, an excellent substitute for platinum weights has recently been found by Mr. Guillaume, of the International Bureau of Weights and Measures, in coöperation with the same firm that aided him in producing the well known iron-nickel alloy invar. This substitute, which has practically all of the requisites of a standard of mass, namely is non-porous to gases or liquids, homogeneous, non-hygroscopic, non-magnetic and non-corrosive, is an alloy of copper, chromium and nickel, the composition of which was determined only after many trials extending over a long period of time.

IMPROVING THE MANGANIN RESISTANCE STANDARD—Our electrical friends are not wholly satisfied with their manganin standard ohms, and investigations are being carried on in several places, including the Bureau of Standards in coöperation with manufacturers, in the systematic search for a better resistance material, with encouraging results.

TESTING WORK AT THE BUREAU—In metals there is a great deal of testing done for various departments of the national government. The greatest amount is done for the Isthmian Canal Commission and the Supervising Architect's office, and in addition to iron and steel it commonly ranges over some 40 non-ferrous alloys and about 20 types of coated metals, including some 500 samples per year of various bronzes, brasses and white metals, and several hundred samples of terne plate and galvanized iron. During the past fiscal year there were also 247 metallographic tests, including heat treatment, cooling curves, melting points and microscopic examination. This routine work is extremely useful for serving as a basis for supplying data upon which to base specifications.

COOPERATIVE WORK—One of the most appreciated fields of common endeavor has been the preparation, analysis and distribution of standard chemical samples, metals and metallic ores, in which several societies, many manufacturing firms and a great number of individuals have taken an active part. The Bureau will soon issue a rolled brass, carefully analyzed like its irons, steels and ores, for the purpose of checking analysts and their analytical methods. The preparation of a cast brass is also contemplated, and in fact, a sample was prepared and nearly ready for analysis, when it was spoiled in the process of mixing. This brass, containing 5% of lead, became very dark-colored during the operation of mixing in the machine specially designed for the purpose

*Extracts from a paper by Dr. G. K. Burgess, Chief of the Division of Metallurgy, Bureau of Standards, before the American Institute of Metals, October 15, 1913.

of mixing metal chips, and it was found that the lead alone seemed to have undergone marked oxidation. The sample had to be discarded and will not be replaced until some method of casting is devised that will insure the requisite homogeneity without mixing.

The experimental study now being made, in coöperation with a committee of the American Institute of Metals, at the Pittsburgh laboratories of the Bureau, of the methods of casting bronzes and brasses with a view to determining and controlling the factors that influence the tensile strength of the casting, I mention here only for the sake of completeness.

SPECIAL DETERMINATIONS—The specific resistance and temperature coefficient of copper have been experimentally determined with great exactness and thoroughness, and the Bureau's results for these constants, which are of the greatest importance to the electrical industries, have been adopted not only by the interested technical societies in America but are also recognized abroad as authoritative. Wire tables for cables based on these experiments have also been computed.

The secular behavior of manganin wire resistance standards has been studied, and the effect of moisture on their indications has been eliminated.

The radiation constants for a great number of metals have been determined at ordinary temperatures, and some progress has been made on measurements of the spectral and total radiation of metals and oxides at high temperatures, including a study of the variations with temperature. This investigation has a very practical bearing, in its application to the metallurgy of metals the temperature of which it is desired to determine during any operation; since the corrections to apply to the various types of radiation and optical pyrometers when sighted on the several metals and oxides is determined from such radiation measurements.

A matter that has bothered the chemists a good deal is the loss in weight and deterioration of platinum crucibles and ware when heated. Some work has been done at the Bureau in coöperation with a committee of the American Chemical Society, and this is still in progress.

The temperature scale is largely defined and maintained in terms of the melting points of some of the pure metals such as zinc, antimony, silver, copper, gold, palladium, platinum and tungsten. A great deal of work has been done in our laboratories and published, on the determination and reproducibility of melting-points suitable for pyrometric standards.

Recently a micropyrometric method has been devised permitting the exact determination of the melting-points of metals and alloys with quantities as minute as 0.001 mgr. Using this method the melting-points of all the refractory chemical elements are being determined.

The results on elements of atomic weight 48 to 59 have been published. In this work we are having the hearty cooperation of many chemists from all over the world. Similarly, with Sir Robert Hadfield, who furnished the samples, there are being determined the melting-points of several hundred analyzed alloy steels.

Hopper-Bottom Steel-Frame Box Cars for Grain; Canadian Pacific Ry.

The transportation of grain is an important item in the freight business of Canadian railways, due to the remarkable development of grain-growing areas in the northwest, and a good deal of attention is paid to the proper handling of this traffic. The grain is handled in box cars, and the Canadian Pacific Ry. has introduced a special form of hopper-bottom box car designed for this traffic in order to prevent the loss of grain which commonly occurs with the ordinary box car. This loss occurs especially around the door openings, and various types of grain-doors have been invented to stop the leakage of grain. One of these new cars is shown in Fig. 1.

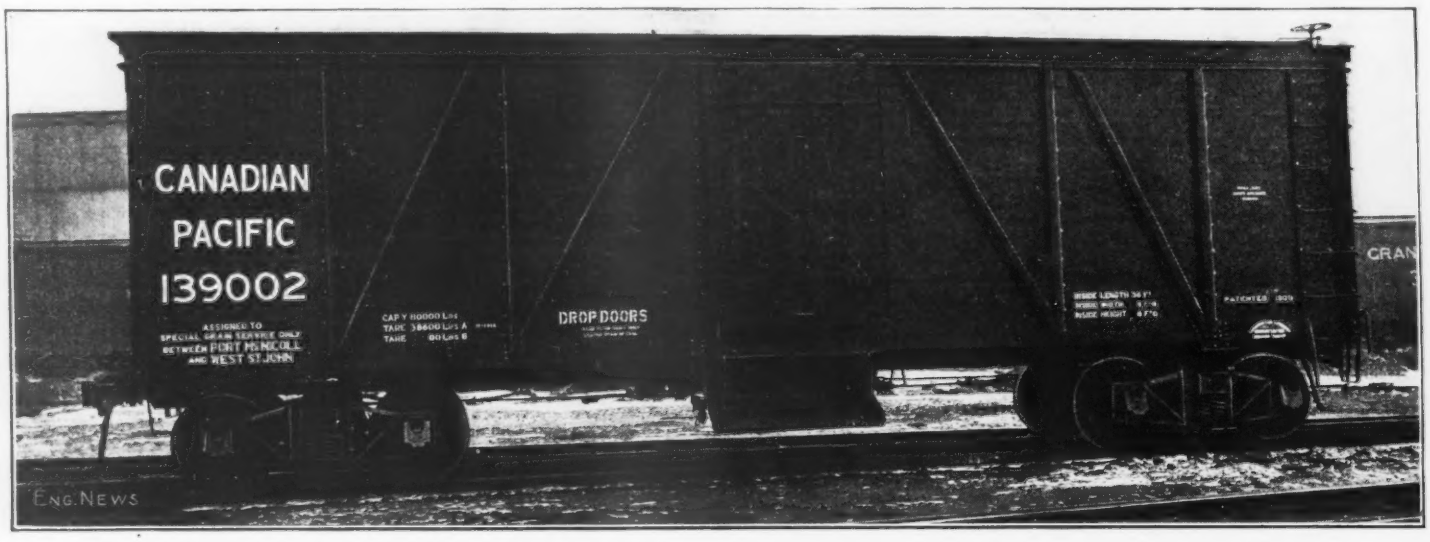

FIG. 1. HOPPER-BOTTOM STEEL-FRAME BOX CARS FOR GRAIN AND COAL; CANADIAN PACIFIC RY.

(R. W. Burnett, General Master Car Builder, Designer.)

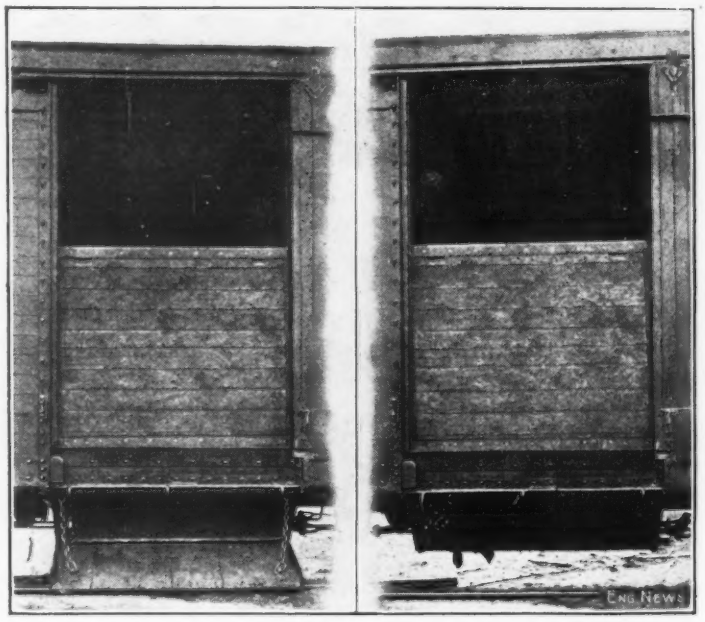

FIG. 2. STEEL HOPPERS AND UPPER GRAIN DOORS OF HOPPER-BOTTOM BOX CARS

(The hopper is shown open at the left, and closed at the right.)

In the new type of car there is a side-discharge hopper on each side, at the mid-length of the car and directly under the ordinary side-door opening. The slope of the hopper begins at the upper edge of the center sill.

The outer door of the hopper is hinged at the bottom, forming a chute when lowered and being almost vertical when closed. It is operated by hand, and is held in its closed position by lugs on a locking shaft above its upper edge, so that it cannot bulge or buckle between the fastenings. The ends of the door are flanged and when the door is closed these flanges lie in recesses or pockets formed by the side plates of the hopper. In this way a tight joint is made, which is proof against leakage, while the flanges are protected against distortion and the grooves serve to stiffen the hopper sides. The hoppers and their doors are of steel. In Fig. 2, the left-hand view shows the hopper door open, while the right-hand view shows it closed and locked.

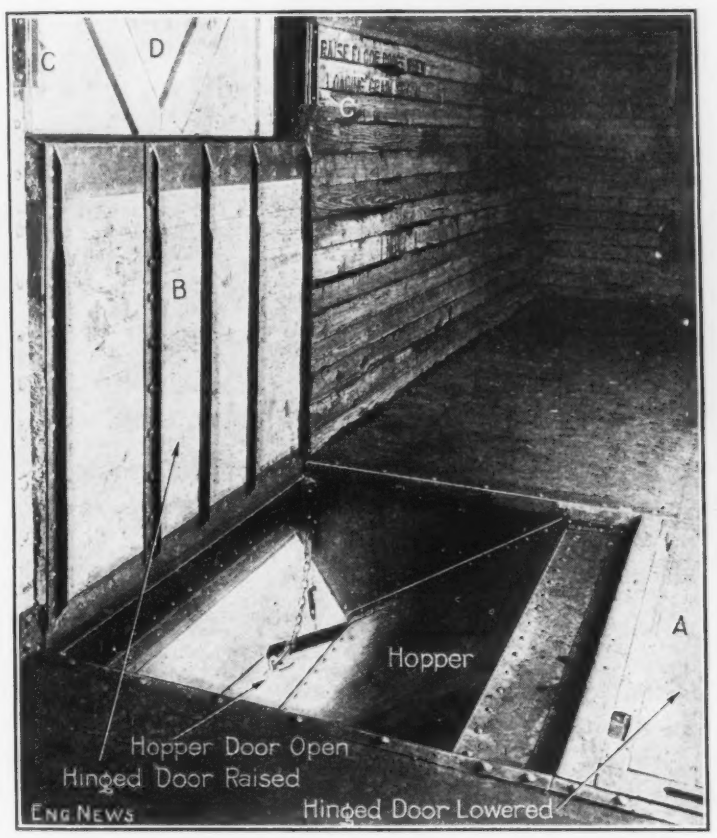

FIG. 3. INTERIOR OF BOX CAR, SHOWING SIDE-DISCHARGE HOPPER AND INSIDE GRAIN DOOR; CANADIAN PACIFIC RY.

On the inside of the car is a steel door frame hinged just inside the upper edge of the side sill, and fitted with planking. When the car is used for any traffic not requiring the use of the hopper, these two doors are lowered, and fit flush with the floor, as shown at *A*, on the right, in Fig. 3. When the car is to carry grain (or coal), the doors are raised, fitting tightly between the posts of the side doors, while the bottom closes against the side sill so that there can be no leakage over this sill. This is shown at *B*, at the left, in Fig. 3. Above the door are placed Z-bars *C*, on each side of the opening, so that if the car is to be loaded to a height above the level of this door, planks can be fitted between the Z-bars, above the door. The regular sliding side doors are closed and secured, of course, as at *D* in Fig. 3. In Fig. 2, however, the side door is open in order to show the special grain-door formed by raising the hinged section of the floor.

It will be seen that full reliance is placed upon the hopper doors to prevent leakage at the hoppers, no auxiliary door or partition being fitted. The efficiency of these doors in this respect is due to the peculiar fitting of the edge and sides against the corresponding parts of the hopper, as noted above. To test this efficiency, the hopper is filled with flax-seed and then jarred by striking it with a hammer, the vibration tending to cause the seed to flow almost as freely as water. The cars are required to stand this test, and we are informed that no loss of grain has been detected since these cars were put in service late in 1912.

In unloading grain, the locking shaft of the hopper door is revolved so as to release the door, which then falls open to a position limited by the side chains. About half the load will flow out through the hoppers. Then the inside doors can be lowered to the floor, the outer sliding doors opened, and the remainder of the grain swept out by power shovels or scrapers in the usual way. The unloading is said to take only 66% of the time required with ordinary box cars.

The hopper and folding-door equipment cost about $50 and increase the weight about 800 lb., as compared with the ordinary box car. But the latter will require special inside grain doors and attachments when used to carry grain, so that when cars of the two kinds are loaded with grain there is little difference in their weight. The extra cost, also, is largely (if not entirely) offset by eliminating the expense of fitting, and removing temporary grain doors (with their nailing strips and attachments) in the ordinary cars.

A special feature of these new cars is that they are designed with a view to hauling grain to the coast and coal on the return trip, thus reducing the empty mileage and getting greater service from the cars, while reducing the amount of equipment required for special classes of service. They can be used also in ordinary freight service.

About 200 of these hopper-bottom box cars have been built, and it may be noted that they are steel-frame cars, with the plank side sheathing attached to the inside of the steel body framing, as shown in Fig. 1. They are mounted on arch-bar trucks. In inside dimensions they are 36 ft. long, 8 ft. 6 in. wide and 8 ft. high. The rated capacity is 80,000 lb., and the weight of car empty is about 38,600 lb. The cars were built by the Canada Car & Foundry Co.

This type of hopper-bottom box car has been designed and patented by R. W. Burnett, General Master Car Builder of the Canadian Pacific Ry., and we are indebted to him for photographs and information.

❖

Five Railway Valuation Districts, each approximating 50,000 sq.mi. of territory, have been announced by the Interstate Commerce Commission. The districts, with their headquarters cities (in parenthesis) are as follows:

EASTERN—(Washington, D. C.), Connecticut, Delaware, District of Columbia, Maryland, Massachusetts, New Hampshire, New Jersey, New York, North Carolina, Pennsylvania, Rhode Island, Vermont, Virginia and West Virginia.

SOUTHERN—(Chattanooga, Tenn.), Alabama, Florida, Georgia, Indiana, Kentucky, Mississippi, Ohio, Panama, Porto Rico, South Carolina and Tennessee.

CENTRAL—(Chicago), Arkansas, Illinois, Iowa, Louisiana, Michigan, Minnesota and Wisconsin.

WESTERN (Kansas City), Colorado, Indian Territory, Kansas, Missouri, Nebraska, North Dakota and Texas.

PACIFIC—(San Francisco), Alaska, Arizona, California, Idaho, Montana, Nevada, New Mexico, Oregon, Utah, Washington and Wyoming.

The St. Louis Mechanical Water Filters

By Edward E. Wall*

SYNOPSIS—The author outlines the history of the St. Louis water-supply, from the viewpoint of quality, for about fifty years past. Plain sedimentation and sedimentation aided by coagulation have been tried with improving results as to quality and now filtration, recommended by the late James P. Kirkwood, in 1869, is to be added, but rapid or mechanical, instead of slow sand filters, are being built.

❖

There is now under construction at the St. Louis Water-Works a filter plant with a rated daily capacity of 160,000,000 gal. When completed it will be the largest rapid sand filter plant in the world. A brief resumé of the condition, quality and treatment of the St. Louis water-supply will be necessary in order that the reader may follow the course of events that led up to the final conclusion to install filters.

Until 1904, St. Louis was supplied with untreated Mississippi River water, which had undergone a few hours of plain sedimentation before being pumped to the consumer. The tap water carried from 50 to 600 p.p.m.† of suspended matter, the average turbidity for the year 1902 being about 200. The river water for the same year ranged in turbidity between 100 and 7000 p.p.m., the average being about 2000.

As long ago as 1865 the Board of Water Commissioners sent the late James P. Kirkwood, then chief engineer of the water-works, to Europe, "to inform himself in regard to the best process in use for clarifying river waters used for the supply of cities, whether by deposition alone, or by deposition and filtration combined, making such an examination in each instance as will enable him to report to this Board the general dimensions and special characteristics of the specific works visited by him, so that this Board may be able to appreciate how far the same mechanism and the same or similar combination of materials are likely to be adaptable to the purifying of the Mississippi water at St. Louis."

The following year Mr. Kirkwood made a voluminous report to the Board, recommending slow sand filters, and outlining a tentative design for their construction. The Board did not see fit to follow his recommendations, and the filtration scheme was dropped. In 1869, Mr. Kirkwood writes: "the public mind of St. Louis, so far as it has been expressed, does not yet seem inclined to consider filtration important."

The Board finally adopted plans for new works at Bissell's Point, deciding to depend for clarification upon plain subsidence in settling reservoirs, in the face of Mr. Kirkwood's statement that "they [settling reservoirs] would be an experiment which it might be interesting to have made, but which could not be advised, that I know of, on the faith of its having succeeded elsewhere."

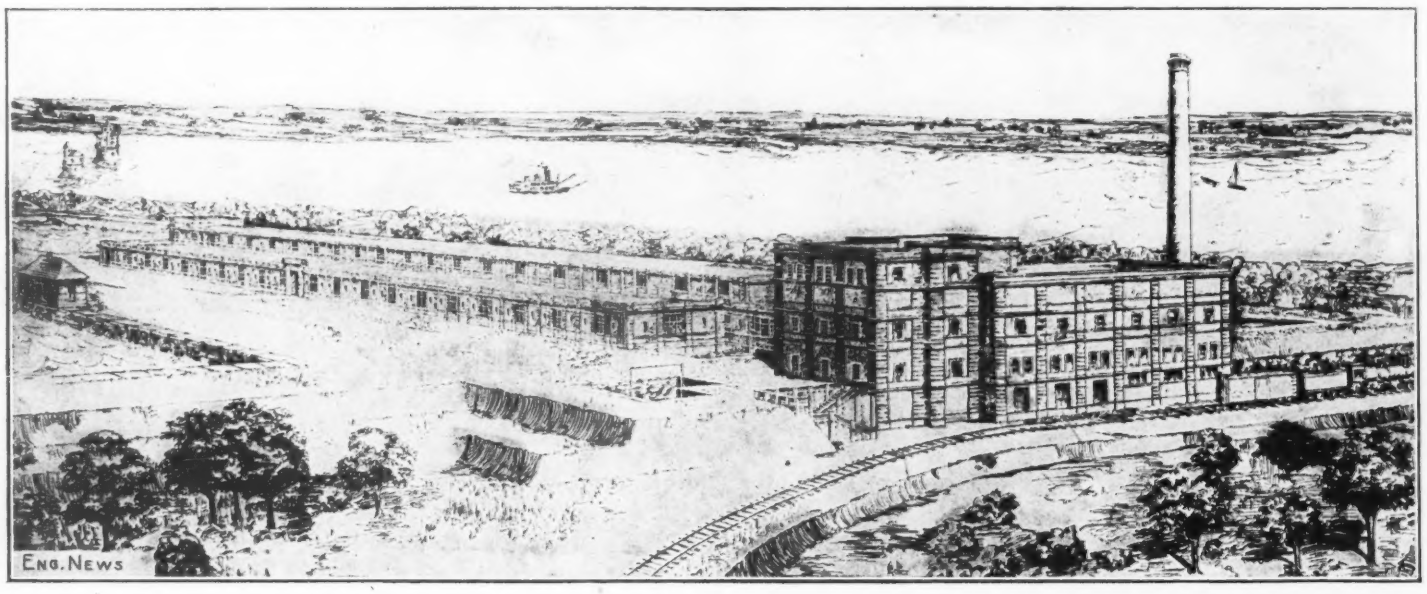

Fig. 1. General View of Chain of Rocks Filtration Plant, St. Louis, Mo., Water-Works
(E. E. Wall, Water Commissioner. Roth & Study, Architects.)

During the years between 1865 and 1900, the desirability of improving the appearance of the water-supply was agitated from time to time, the general belief being that the river water in its natural condition was exceptionally pure and healthy, and only needed to be clarified to silence the complaints of over-sensitive persons of finical taste.

Because of the inadequacy of the Bissell's Point works to supply the growing city, the construction of new works, located at the Chain of Rocks, about ten miles above the business district of the city, was started in 1887. This plant, completed in 1894, and which is still in use, was designed along the same lines as the Bissell's Point works, but with a much larger capacity of settling reservoirs.

When the Chicago Drainage Canal was put in service in 1900, the typhoid death rate began to increase and fil-

*Water Commissioner, St. Louis, Mo.
†Parts per million.

tration was again proposed, this time by Edward Flad, then Water Commissioner, who submitted plans for mechanical filters to the Board of Public Improvements.

Mr. Flad's experience was very similar to that of Mr. Kirkwood, thirty years earlier, and he, also, might well have said: "the public mind of St. Louis does not seem inclined to consider filtration important."

In 1904, a method of clarifying the water by coagulation and flowing sedimentation was put in operation under the direction of the writer. The original design was fully described in ENGINEERING NEWS, Nov. 26, 1903, and later (Oct. 27, 1904) a further account was published in the NEWS, giving in some detail the changes in design brought about through some months' experience with the process of clarification. Other articles by the writer, published in the NEWS, Feb. 20, 1908, and Jan. 11, 1912, described the evolution of the equipment and the operating results of the process.

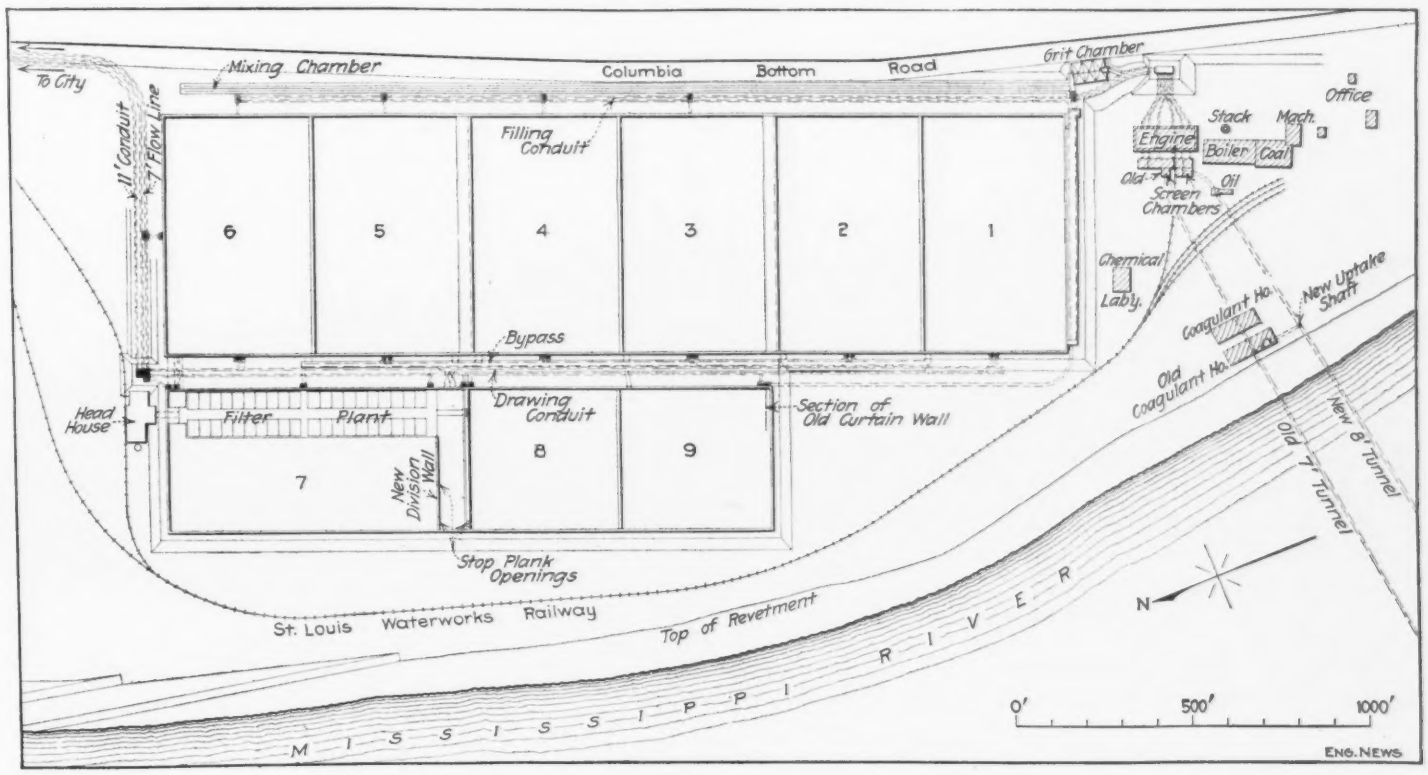

FIG. 2. GENERAL LAYOUT OF NEW FILTER PLANT AT ST. LOUIS WITH REFERENCE TO OLD SEDIMENTATION BASINS

The instantaneous and remarkable improvement in the water-supply of the city encouraged the engineering force of the Department to persist in their efforts to perfect the rather crude original apparatus and treatment, and to eliminate some objectionable features resulting therefrom. After three years' experience it became evident that the capacity of the existing settling reservoirs was insufficient and two new basins were added, increasing the settling capacity from 180 to 250 million gallons.

Toward the end of the year 1911, the necessity of a still greater clarification capacity became so apparent that the system of operation had to be rearranged, in order to admit of greater flexibility in the use of the basins.

The results of the treatment of the river water from 1904 to the present time show very clearly two very grave defects in the process: (1) The water supplied to consumers varied considerably in quality, owing to the wide range in the suspended matter in the raw water, combined with the irregular pumping which varied with the daily consumption, on account of the limited storage capacity for clear water. The maximum pumping frequently coincided with the periods of maximum turbidity of the river water so that at these times the clarification was incomplete. (2) The second defect in the process lies in its inefficiency for color removal. At times the Mississippi water runs over 100 p.p.m. on the platinum scale. With a color of 30 in the river water, a reduction to 12 or less is possible, but a color of 100 parts cannot be reduced below 45. In the autumn of 1911, the color of the water entering the St. Louis intake ran very high, with a maximum of 115 p.p.m., and for several weeks the settling basins contained an exceedingly dark-colored water, and the consumers' faucets delivered an amber-colored liquid, which caused innumerable complaints.

The average daily consumption of water for the year 1911 was 7,400,000 gal. greater than for 1910. This unexpected increase brought home the fact that the waterworks, as a whole, was being operated practically to its full capacity, while the clarification capacity was heavily overtaxed. It seemed to the writer that a definite plan, comprehensive enough to supply the needs of the city for a considerable time in the future, should be worked out and adopted.

On Nov. 1, 1912, the writer submitted to the Board of Public Improvements a report on the capacities and conditions of the various divisions of the water-works, with recommendations for improvements, extensions and new works supplementing the present works, providing sufficient capacity to supply the city until 1960. The report analyzed the capacity, results and efficiency of the purification process since its installation in 1903, compared the cost of increasing its capacity to 150,000,000

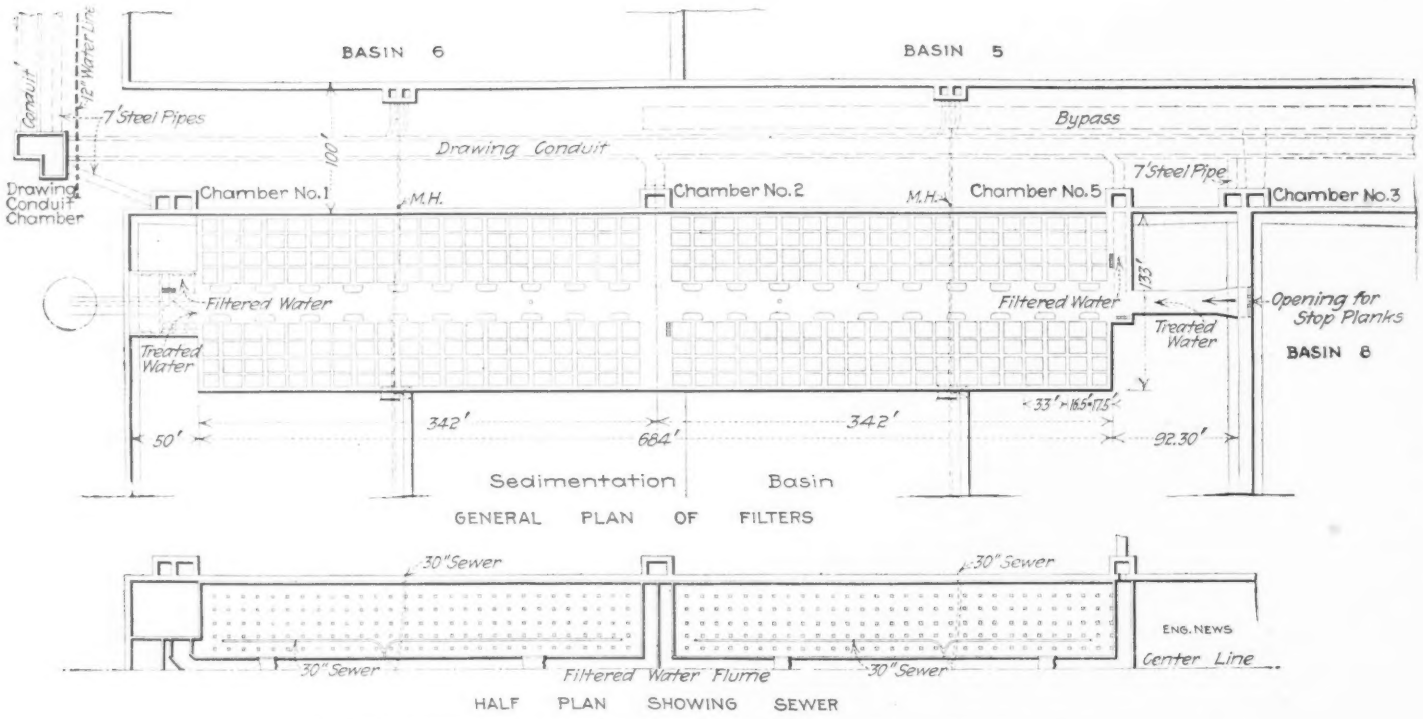

FIG. 3. GENERAL PLAN OF ST. LOUIS MECHANICAL FILTER PLANT

gal. per day, with the cost of building rapid sand filters to supply 160,000,000 gal. per day, reaching the conclusion that the filter plant would not only be more economical to construct and operate, but would also insure a more uniform and better quality of water.

This report recommended that the present works, as a whole, be enlarged to provide a working capacity of 150,000,000 gal., this being the limit to which they could be economically increased. Provision for a greater supply should, in the writer's opinion, be made by the establishment of new works on the Missouri River about 16 miles west of the city, at an ultimate cost of approximately $20,000,000.

The Board of Public Improvements approved the recommendation to enlarge the present works, to construct the rapid sand filters and to build a new intake tower and tunnel. The total cost of the proposed improvements was estimated at $3,075,000, including certain additions and extensions to the pumping plants and distribution system. Within sixty days after the approval of the general scheme by the Board, plans and specifications for the filter plant and the tower and tunnel were submitted, approved and forwarded to the Municipal Assembly, with bills appropriating $750,000 for the construction of the first and second sections of the work. Contracts for the filters, filter equipment and the tower and tunnel have been let, and the construction is now in progress. Bids for the construction of the filter house will be asked for in a short time.

Plans for the head-house are practically completed. Fig. 1 is a general view of the new filter plant as it will appear when completed and Fig. 2 shows the arrangement of basins, conduits, chambers, filters and connections. There will be forty filter units, each 50x28 ft. in plan. The filters are being built in the western part of Sedimentation Basin 7, and will occupy a space approximately 700x140 ft. (Figs. 3 and 4). On the original basin floor inverted-concrete arches are laid to distribute the foundation loads of the columns supporting the filters. Each concrete filter box will be poured as a monolith on the 9-in. reinforced floor joining the columns.

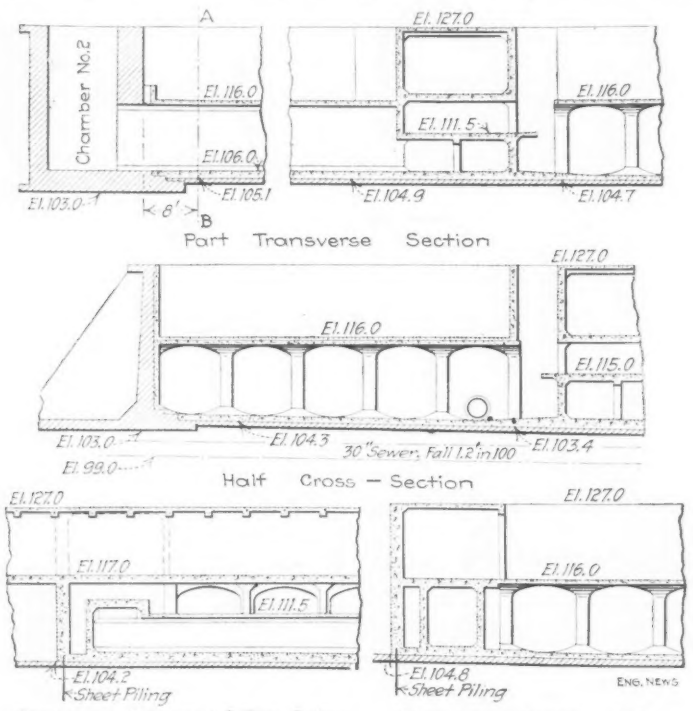

FIG. 4. SELECTED PORTIONS OF LONGITUDINAL AND CROSS-SECTIONS, ST. LOUIS FILTER PLANT

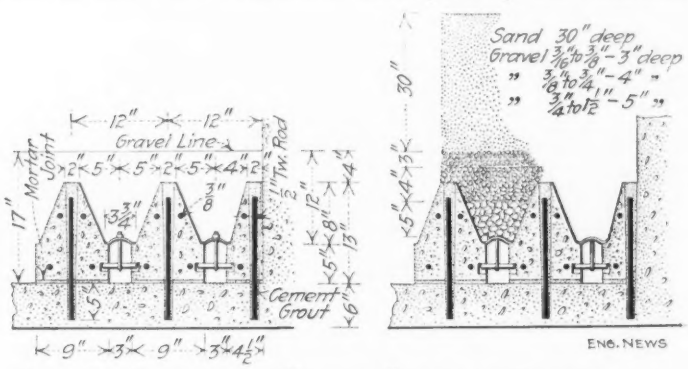

FIG. 5. DETAILS OF FILTER STRAINER PLATES AND ARRANGEMENT OF GRAVEL AND SAND, ST. LOUIS FILTERS

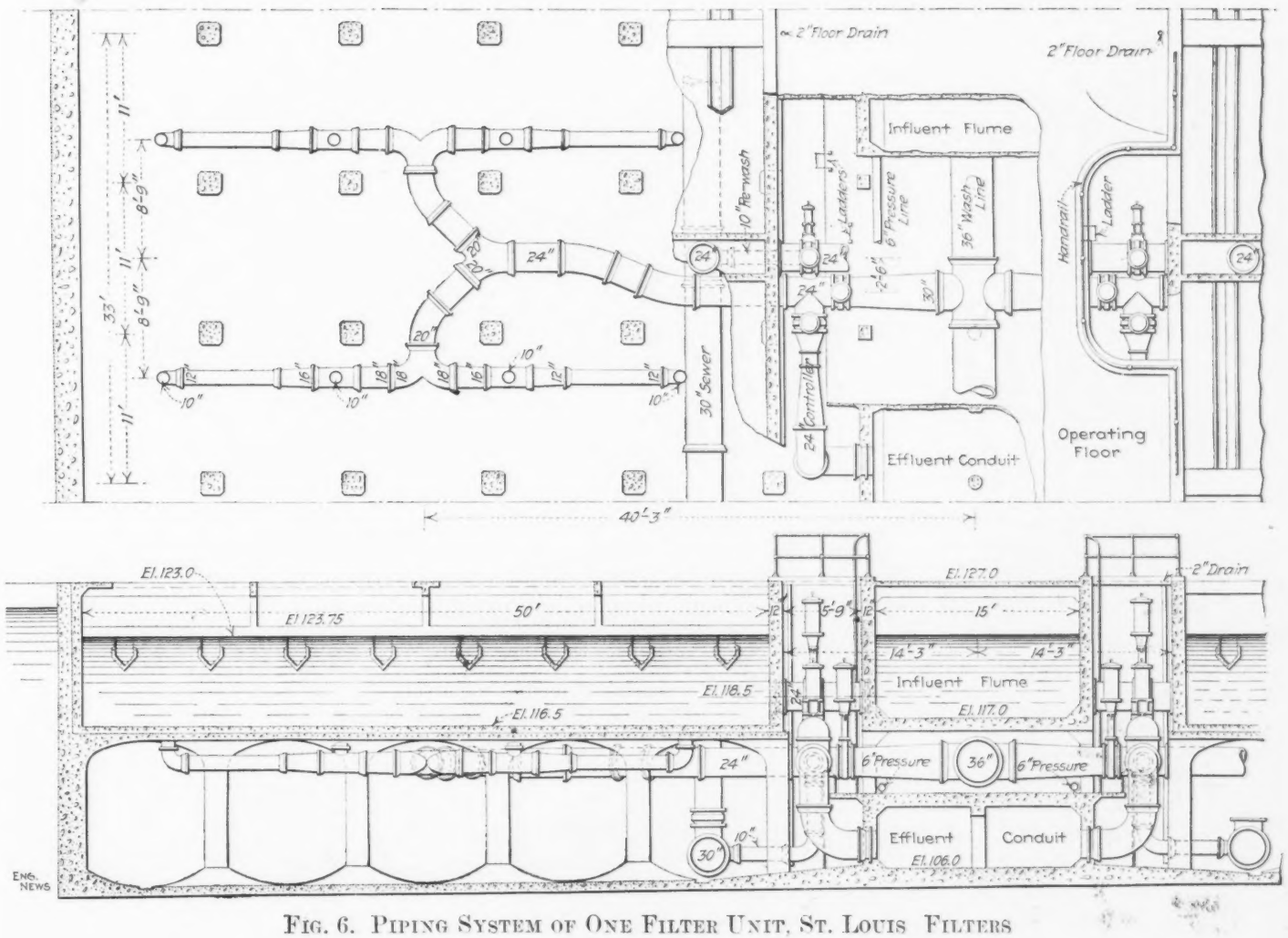

FIG. 6. PIPING SYSTEM OF ONE FILTER UNIT, ST. LOUIS FILTERS

The concrete in the arches and columns will be a 1:2½:5 mixture, while that in the filter boxes and conduits will be 1:2:4. All the coarse aggregate will be gravel, screened and washed.

The floor of the filter is of the well known V-shaped bottom with bronze strainer plates anchored to the concrete blocks by bronze bolts, as shown in Fig. 5. A channel 3 in. wide and 5 in. deep under each strainer plate empties into the main collecting channel, 28 in. wide and 5 in. deep, of which there are two to each filter unit, and which are drained through eight 10-in. openings connected by cast-iron pipe to the effluent conduit, as shown by Fig. 6. The sizes of the gravel and sand and the depths of the several layers of each are shown in Fig. 5. The bronze wire screen, which usually separates the gravel and sand in filter installations, will be omitted. The sand will have an effective size from 0.40 to 0.50 mm. and a uniformity coefficient not greater than 1.65.

The pipe gallery (Fig. 7) is 28½ ft. wide. It will contain the effluent conduit, 15 ft. wide and 4½ ft. high, built of reinforced concrete, over which lies the cast-iron wash-water pipe, 36 in. in diameter, to which each filter unit is connected by a 24-in. pipe. Above this is the influent flume, 15 ft. wide and 10 ft. high, also built of reinforced concrete, into which the water from the secondary coagulating basins can be drawn at either end of the filter house. Two main sewers, 30 in. in diameter, will carry the wash water from the filters, and all drainage to the river. Directly under the filters, branches from the main sewers will be connected to all the wash-water troughs.

On the effluent pipe of each unit will be placed a rate

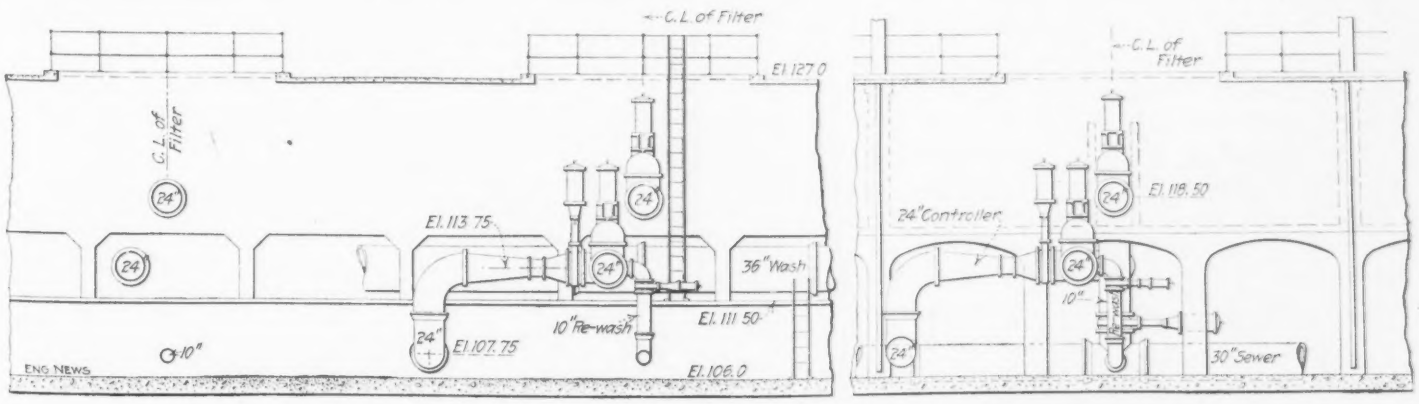

FIG. 7. LONGITUDINAL SECTION THROUGH PIPE GALLERY, ST. LOUIS FILTERS

controller, capable of constantly maintaining any desired rate of flow between 1,500,000 and 5,000,000 gal. daily, regardless of the difference in head on the two sides of the controller, which may amount to as much as 14 ft. The variation between the actual and the registered flow shall not be more than 3% of the registration when it is below 2,500,000 gal. per day, and not more than 1½% when it is above that amount.

Each controller will be provided with suitable mechanism for setting it at the desired rate of flow, and will also be connected to a general controlling device, which, when set at any desired rate of flow, will automatically set all the unit controllers at the same rate. Each unit controller will be equipped with a mechanism for recording on one chart the actual rate of flow, the loss of head and the elevation of the water on the filter.

There will be a Venturi meter placed on the 36-in. wash-water pipe, which will indicate and record all flows up to 42,000 gal. per min. The water level in the effluent conduit will be indicated and recorded by a gage placed at the outlet at the center of the filter house.

Operating tables of the usual type, equipped with valve levers, gages, sample pumps, etc., will be located on the operating floor of the central gallery.

The filter house will be built entirely of concrete, with metal window sash and frames. The building will fully inclose the filters, the ceiling beams being 11⅔ ft. above the operating floor at the side walls. On account of the depth of the main beams supporting the roof, they will be projected above the roof 19 in., to give a uniform depth to all beams inside the building. The lantern will be the full width of the central gallery, and extend 6½ ft. above the main roof. The building, 699x134 ft., will be heated from a steam plant on the ground floor of the head-house, which will be located 34 ft. south of the filter house.

The head-house will be a four-story concrete building, containing on the first or ground floor, three 150-hp. boilers, four alum-solution tanks, two alum-solution pumps, three 12-in. centrifugal pumps for supplying the wash-water tanks, two 6-in. pressure pumps for hydraulic valves, a four-ton refrigerating plant for manufacturing ice for the Department, a storeroom for chemicals (hypochlorite of lime and liquid chlorine) and a small machine shop; on the second floor will be located an office, a small laboratory, six alum-mixing tanks, washrooms, lockers and storeroom; two wash-water tanks, each 50 ft. in diameter, and containing 175,000 gal. of water between working levels, will occupy the greater part of the third and fourth floors. The dome-shaped covers of these tanks will form part of the roof of the building. Also on the third floor will be the solution tanks for hypochlorite of lime and the liquid chlorine apparatus.

There will be space on the fourth floor for the hypochlorite-mixing boxes, and storage for alum. Coal, alum and other supplies will be delivered in cars on a switch running along the south side of the head-house. Alum will be unloaded from the cars directly into an elevator, which will deliver it to the storage bins on the fourth floor. The alum solution will be pumped from the head-house to the chamber north of the filter house, while the hypochlorite solution, when used, will be conducted through fiber pipes to the drawing-conduit chamber, where also liquid chlorine will be applied, if it is used.

The present method of operating the settling basins wholly or in part in series, will be abandoned, and they will be used in parallel.

The division walls between basins, which were cut down in 1904, will be rebuilt, and Basins 1, 2, 3, 4, 5, 6 and 9 will be used as primary coagulating basins. Basin 8, and that portion of Basin 7 not occupied by the filters, will be used for secondary treatment with alum when necessary. The water turned on the filters will not carry more than 40 p.p.m. suspended matter. The water will be drawn from the primary basins in a concrete collecting conduit, varying in height from 3½ to 7 ft., in

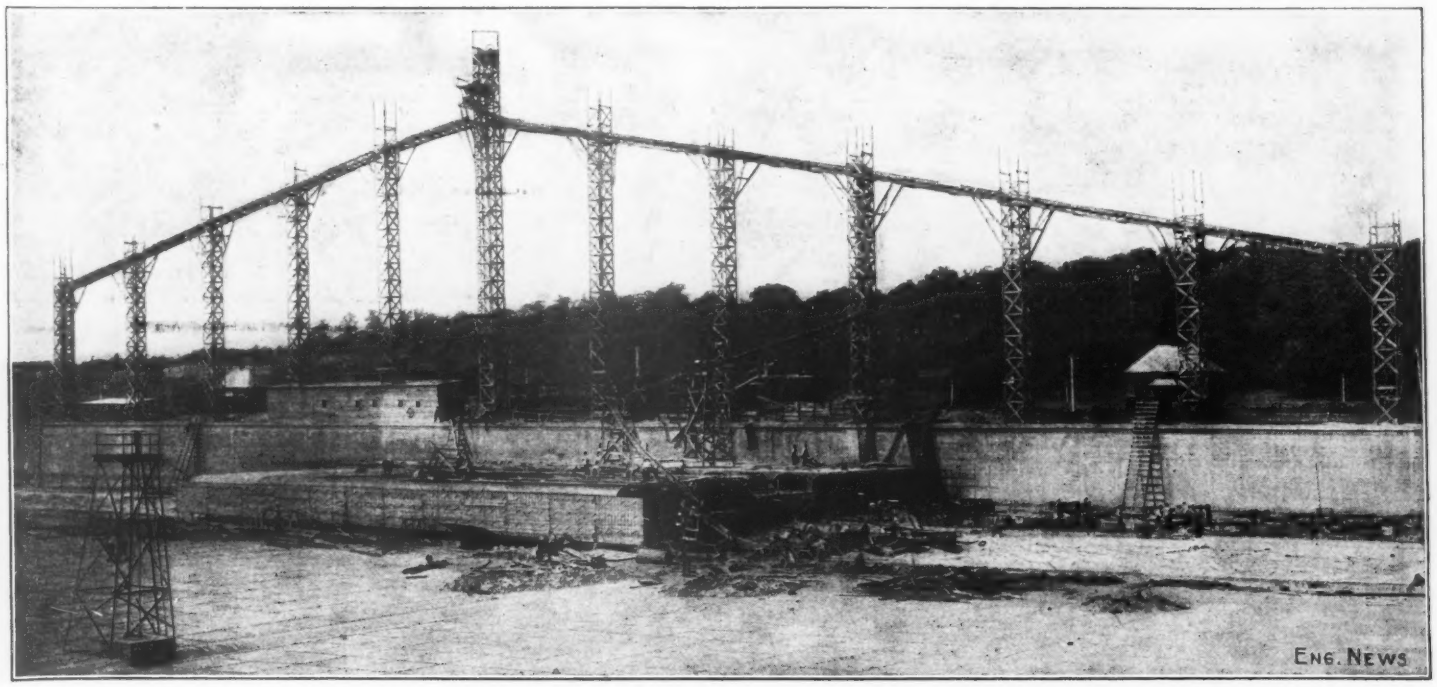

FIG. 8. ST. LOUIS FILTERS UNDER CONSTRUCTION, SHOWING CONCRETE MIXING AND PLACING PLANT

(The 40 mechanical filter units, each 50x28 ft. in plan, are being built upon the concrete floor of one of the existing sedimentation basins. The floor of each unit consists of inverted groined arches, which support the columns which carry the roof of the filters.)

width from 14 to 26 ft., located between the first six basins and Basins 7, 8 and 9. This collecting conduit will deliver the water into either Basin 7 or 8 through a chamber at the north end of the filter house, the flow being measured by Venturi meters. Whatever secondary treatment is necessary will be applied to the water as it enters this chamber, or just before it goes on the filters.

Before the water reaches the primary basins, and before any chemicals are added, it is proposed to pass it through a grit chamber 60x100 ft. in plan, located as shown on Fig. 2, where the heaviest of the suspended matter will precipitate, and which will be flushed out as often as necessary through a 36-in. sewer to the river. As the water leaves the grit chamber it will receive the charge of lime, and enter the mixing chamber, 30 ft. wide, 2400 ft. long and 11 ft. deep, divided into four channels, located as shown on Fig. 2.

These channels may be used singly, forcing the water to travel 9600 ft. from the grit chamber to the filling conduit, or they may be used in pairs, reducing the distance traveled one-half. Or by changing the stop planks, 1200 ft. south of the grit chamber, one-half of the mixing channels may be cut out of service.

The object of this design is that the carrying capacity of the mixing channels may be varied to follow more nearly the irregular pumping, so that the velocity of water throughout its course may be maintained sufficiently high to prevent settlement in the conduit.

The charge of sulphate of iron will be applied to the water as it leaves the mixing channels and enters the filling conduit, from which it is delivered to the basins. Each inlet to the basin will be baffled, so as to prevent any direct flow across the basin to its outlet. Both the solution of sulphate of iron, and the milk of lime will be prepared at the present coagulant house, and pumped from there to the points of application.

Under the present system of clarification, the average quantities of lime and iron sulphate per gallon of water used last year were respectively 5.23 and 2.97 grains, 12,448 tons of lime and 7082 tons of iron sulphate being used. Through the use of the grit chamber and mixing channels, the quantities of lime and iron sulphate will unquestionably be considerably reduced.

The water will be softened to the same extent as under the present process, except that at times the permanent hardness may be slightly increased through the use of alum in the secondary basins.

The entire work of building the filter plant, making all changes and connections to existing structures, and constructing the grit chamber and mixing channels will be completed and in operation on or before Jan. 1, 1915, which will be less than two years from the time that the Board of Public Improvements approved the general scheme and authorized the Water Commissioner to prepare plans and specifications.

The principal contractors for the work now under construction are as follows: substructure and concrete filter boxes, McCormack-Coombs Construction Co., St. Louis, Mo., $225,024; filter equipment, Pittsburgh Filter Manufacturing Co., Pittsburgh, Penn., $398,200.

The completion of this work, with certain proposed extensions and additions to the pumping plants and to the distribution system, will bring the water-works of St. Louis to a working daily capacity of 150,000,000 gal. of water, clear, sparkling and absolutely pure.

The Illinois Law for Licensing Mason Contractors*

The Illinois legislature has passed a law "to provide for the licensing of mason-contractors and employing-masons and to regulate the safe and proper construction of buildings." It applies to all cities having a population of over 150,000 and as originally introduced it specified a license or certificate fee of $200 (good for one year) , with a charge of $100 per annum for renewal of the license. As passed, the amounts of the fees are left to the decision of the city council, so that the force of the law is weakened considerably. Few cities have yet taken action under the law. It is required that a board of examiners shall be appointed by each city within three months from the passage of the law, and rules and regulations governing mason work prescribed within the same period. The law is given below, practically in full:

1. In all cities of this State of 150,000 inhabitants or over, every mason contractor or employing mason shall be required to obtain an annual license therefor, in the manner following:

2. Every person desiring to engage in the business of mason contractor or employing mason shall make application to a Board of Examiners, and shall, at such time and place as said board may designate, be compelled to pass such examination as to his qualifications as said board may direct. Said examination may be made in whole or in part in writing and shall be of a practical and elementary character but sufficiently strict to test his qualifications.

3. In every city of 150,000 inhabitants or over, there shall be a Board of Examiners of mason contractors or employing masons, consisting of three members, one of which shall be the Building Commissioner, who shall be ex-officio chairman, one shall be a practical architect and one shall be a practical mason, who shall be appointed by the mayor and approved by the city council within three months after the passage of this Act, for the term of one year from May 1 in the year of appointment and thereafter annually before May 1, and shall be paid from the treasury of said city such sum as the officers may designate.

4. Said Board of Examiners shall, as soon as may be convenient after appointment, meet and shall then designate the times and places for the examination of all applicants desiring to engage in or work at the business of mason contracting or employing masons within their respective jurisdiction. Said board shall examine said applicants as to their practical knowledge of masonry and mason construction and all matters pertaining to mason construction and, if satisfied of the competency of such applicants, shall thereupon issue a certificate to such applicant, authorizing him to engage in the business of mason contracting or employing masons.

The license or certificate fee for such mason contractor or employing mason shall be fixed by the common council. Said certificate shall be valid and have force throughout the State for a period of one year from date of issuance, and may be renewed upon its expiration by paying in advance an annual renewal fee to be fixed by the common council. All fees received for said license or certificate shall be paid into the treasury of the city where such certificates are issued. Provided, that wherever a firm or corporation consists of more than one master or employing mason, it shall not be necessary for more than one member of said firm or corporation to procure a license certificate.

5. Each city shall, by ordinance or by law, within three months of the passage of this Act, prescribe rules and regulations for the materials, construction, alteration and inspection of all mason work placed in or upon or in connection with any building in said city; and the Building Department shall provide that no mason work shall be done upon any building without a permit being first issued therefor upon such terms and conditions as such city shall prescribe.

6. All persons who are required by this Act to take examination and procure a certificate as required by this Act shall apply to the board in the city where he resides or to the board nearest his place of residence.

7. Any person violating any provision of this Act shall be deemed guilty of a misdeameanor and shall be subject to a fine of not less than $5 nor exceeding $50 for each and every violation thereof, and his certificate may be revoked by the proper authorities in said city.

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Engineers vs. Lawyers or Progress vs. Precedent—Until the past few years the language of specifications was to a great degree modeled after that commonly used in legal documents—some of it verbose in the extreme. Many of these wordy expressions may be traced back to the days when compensation for drawing up legal papers was largely dependent on the number of words they contained. The efforts of a number of clear-headed writers among the engineering profession have brought about a decided improvement in this direction, and many of the newer specifications are models of concise expression.—Kirby's "The Elements of Specification Writing."

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*The builders license law now in force at Boston, Mass., was given in our issue of Oct. 2.

FIELD AND OFFICE

Construction Trestles with Old Rails for Stringers

In the reconstruction of the line of the Pennsylvania R.R. at Rahway, N. J., the Keystone State Construction Co. has a considerable length of timber trestle in which the stringers are made of old rails discarded by the railway. These trestles are of two types, one used as a construction railway and the other as a filling trestle which is covered by the fill as it progresses. They are both detailed in the accompanying cuts.

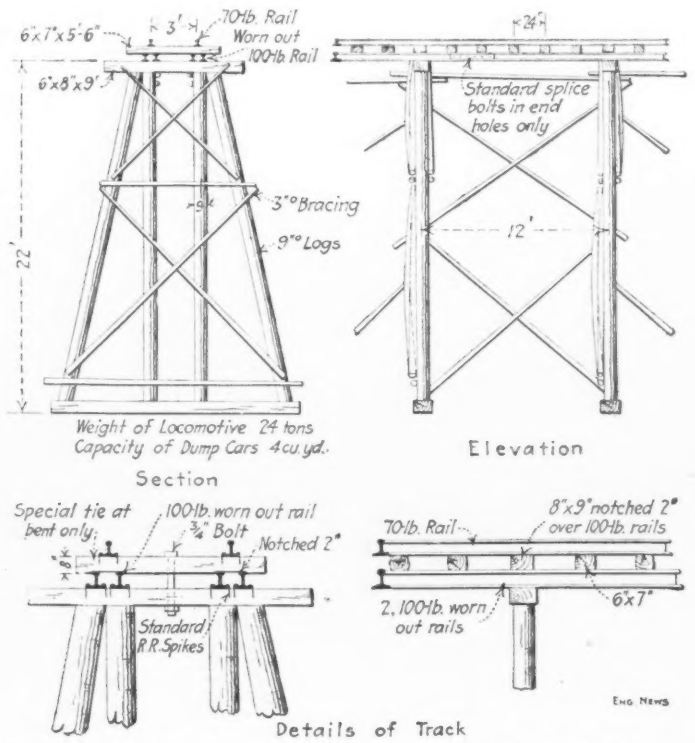

FIG. 1. CONSTRUCTION TRESTLE WITH RAIL STRINGERS
(Pennsylvania R.R. track elevation, Rahway, N. J., The Keystone State Construction Co.)

The construction railway trestle is the heavier of the two (Fig. 1). It is made up of the usual framed bents with round log uprights and sapling braces and a squared 6x8-in. cap. On this cap run the stringers, four old 100-lb. rails, in groups of two, spanning the 12-ft. opening between bents. These rails are spiked with standard railway spikes to the cap and are spliced wherever the breaks come with the standard rail splices with bolts only in the end holes.

The 3-ft. gage construction track is built of old 70-lb. rails spiked to 6x7-in. ties with an 8x9-in. tie dapped 2 in. over the stringer rails at the bents. These latter ties are bolted with ¾-in. bolts to the bent caps, and this is the only fastening of the track to the bents or stringers.

The filling trestle is shown in Fig. 2. In it the track rails also act as stringers. This track is of 3-ft. gage and is made up of old 100-lb. rails, spiked to 6x7-in. ties, which act merely as spacers between bents and as caps at the bents. The dirt train is backed onto the trestle and the cars are dumped at the edge of the fill so that

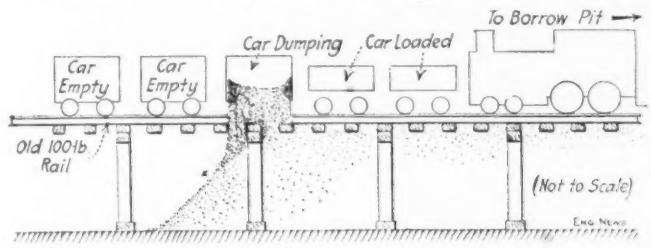

FIG. 2. FILLING-TRESTLE WITH TRACK SPANNING BETWEEN BENTS

no load but that of empty cars comes on the trestle. The ties and rails remain in the fill and form the construction track on the embankment.

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Building with Traveling Tower-Cranes

Derricks are almost unknown in European building construction work. Hoisting with hand tackle or with hand-winch elevators is very common. Ordinary building construction includes no heavy interior parts, on account of the limited height of buildings and the virtual absence of steel framing in European practice, and therefore the principal lifting of heavy weights arises in connection with the stone-facing work of the front wall. Under these circumstances, a steel tower crane was introduced about ten years ago by Karl Voss, Berlin, and being both cheap and convenient in use, it has become very popular. Traveling tower cranes of other types are built by various concerns, and almost every building-erection job in Germany at the present time makes use of one form or another of traveling crane.

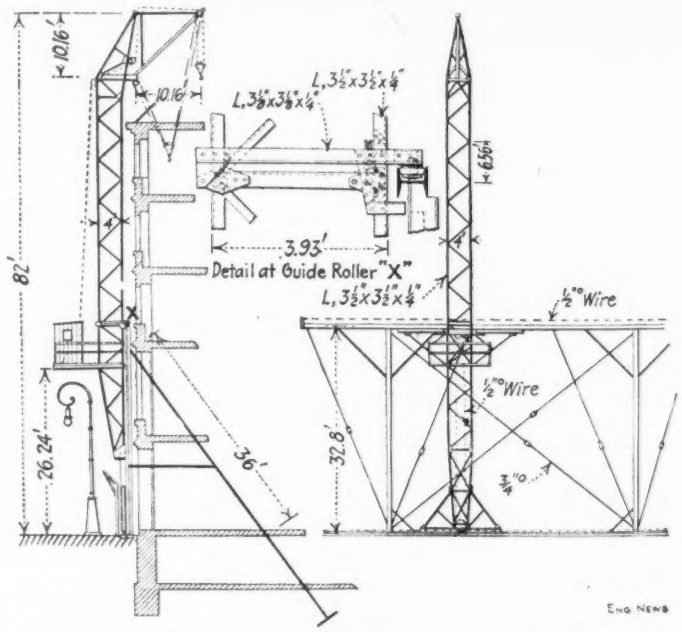

FIG. 1. VOSS TRAVELING TOWER-CRANE FOR BUILDING ERECTION

The drawing, Fig. 1, herewith, shows the general construction of the Voss crane, in its present-day form. The tower is a square four-post steel structure of small horizontal dimensions, supported at the base on a two-wheel track running on a rail laid on the ground close along the front of the building. The tower is held by a horizontal guide roller below midheight, engaging a horizontal I-beam supported by posts and stayed by back legs. On top of the tower is supported a small rotatable crane or derrick, with a reach of about 10 to 12 ft. The operating winches for the crane are on the operator's platform, some distance up the tower. Electric operation is preferred where current is available.

The guide-rail framing of the crane is braced longitudinally by knees and rod diagonals. The backstays are I beams or channels extending diagonally downward from the guiderail to suitable anchorages or supports in the interior of the building. The method of providing this anchorage is various, depending upon the conditions, but in any event the provision for these braces is not a very great complication. According to the concern which handles (rents out) the Voss crane, Voss & Wolter, of Berlin, the backstays need not be spaced closer than about 30 to 35 ft. apart.

Fig. 2 shows a view of a building site where four of the above cranes are in use, mainly for handling the facing stones. This is a monumental building in Munich. In the erection of a new building for the Deutsche Bank, in Berlin, now under construction, a single such crane is used on a building block about 120x200 ft., the street front being 120 ft. long. A store building in Cologne, of reinforced concrete, with a front of about 200 ft., also used only one crane.

Some cranes used for the same purpose as the one above described rest on a four-wheel truck and are self-contained, needing no guiderail. In this case the crane is made somewhat larger in horizontal dimensions and the rotating crane-arm on top swings the full circle, which is not the case with that shown in Fig. 1.

The heights of these cranes are such that they reach to the roof, which means 85 to 110 ft., the height of buildings being everywhere restricted by law and custom. Capacities of 2 to 3 tons are usual.

As to the cost, it may be said that the cranes are nearly always hired by the builder. The rental depends on conditions, of course, but according to statements of the firm of Voss & Walter the total charge for erection, rental and removal amounts to $0.06 to $0.07 per square foot of front wall surface.

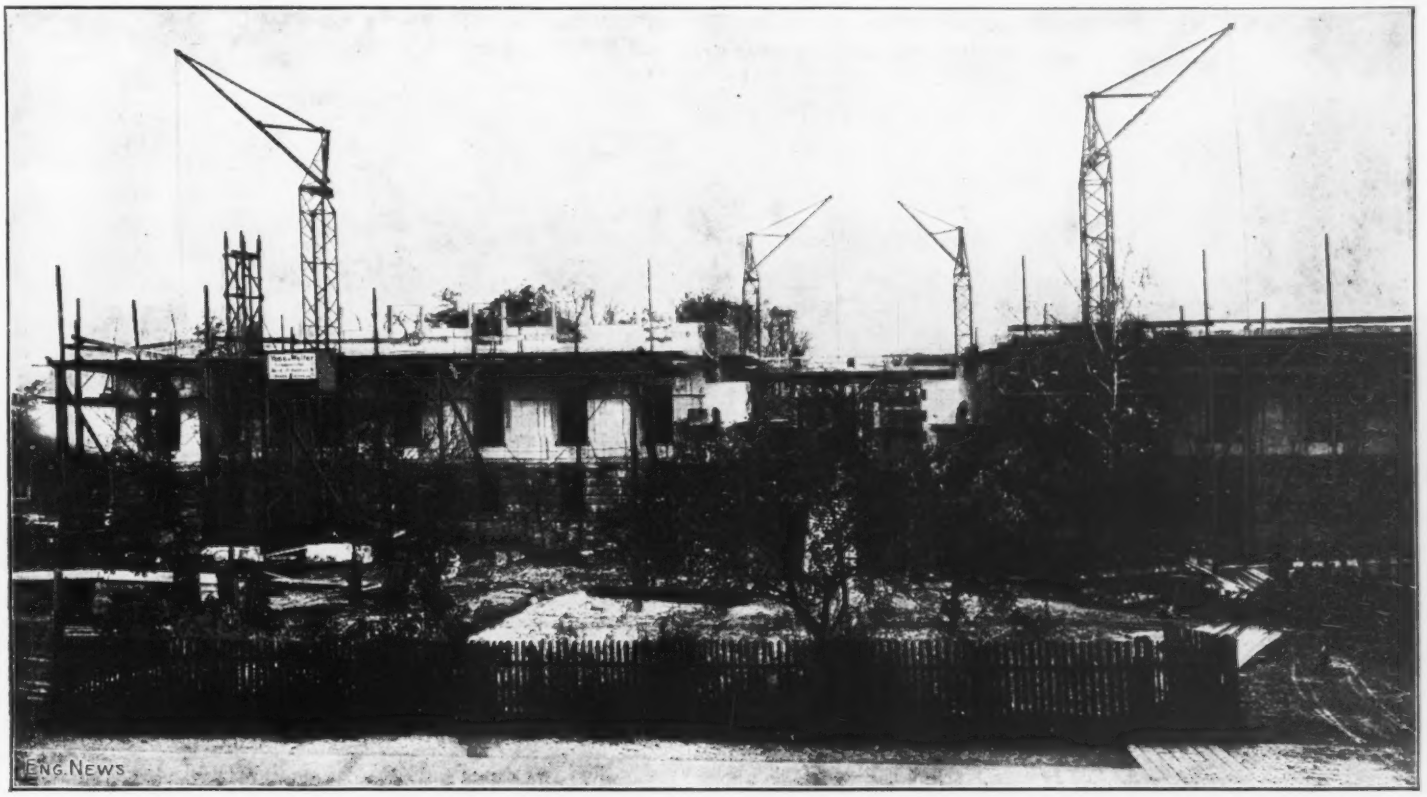

FIG. 2. FOUR TOWER-CRANES ERECTING A MONUMENTAL BUILDING IN MUNICH

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Loading Formulas for Crane-girders—When a crane-girder is to be designed, the capacity of the crane which it must carry is given, but the make of the crane often is not. The cranes of different makers, though built for the same capacity, do not have the same weight per wheel or the same wheel spacing, and the designer must therefore design the crane-girder for a particular crane, or else design with sufficient margin to include all makes of crane. Ernest Owen, Martins Ferry, O., offers formulas for amount and spacing of crane wheel-loads, for use in designing crane girders, in place of crane tables of various makers. Letting

C = Capacity of crane, tons;
S = Span of crane, feet;
W = Wheel-load, thousands of pounds;
D = Spacing of wheels, feet;

the wheel-load is

$$W = 5.1 + \frac{C}{0.85 - 0.0935\,S}$$

and the wheel spacing is

$$D = 7 + \tfrac{1}{10}\,C + \tfrac{1}{40}\,S$$

He says that this formula is based on data taken from the standards of various bridge companies and various crane-builders' catalogs, and has been found to give satisfactory results for electric cranes ranging in capacity from 3½ to 60 tons.

The Design of Concrete Abutments Without Wing Walls for Deck Girders

By C. M. Luther*

In designing concrete abutments for railway bridges, there are certain occasions when it is permissible to let the earth fall in front of the abutment: in other words, certain conditions justify construction of abutments without wing-walls. When such is the case, care must

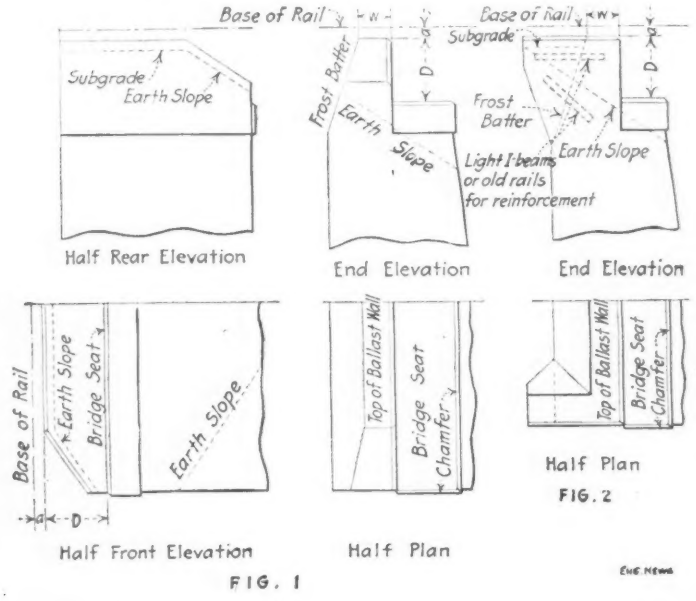


FIG. 1 FIG. 2

be taken to see that the earth does not encroach on the bridge seat.

Assuming that the bridge seat is at some distance above the surface of the ground, the following points enter into the design as important factors, in so far as the question of keeping the earth away from the bridge seat is concerned:

1. Rate of slope of the backfill.
2. Width of the ballast wall proper, and rate of frost batter on back of same.
3. Distance D from the bridge seat to the top of the ballast wall.

In addition to these, the length of the bridge seat as compared with the width of the subgrade or roadbed, and the distance from the subgrade to the top of the ballast wall, also require consideration, the discussion of which, however, will be omitted, as the difficulty arising from these adjusts itself to the circumstances in many cases.

A rock backfill presents but little trouble in this respect as compared with dry, loose earth backfill. This is equivalent to saying that, other factors being the same, the steeper the slope of the backfill, the easier would the solution of the problem be. This can readily be seen by a glance at the accompanying figures, and does not need any further explanation.

The width of the ballast wall is generally taken from 1 ft. 6 in. to 2 ft. 6 in. for ordinary abutments; and there are conditions which forbid the designer to take excessive width. The frost batter on the back of the ballast wall can profitably be made light in abutments for through girders, as in that case the distance from bridge seat to ballast wall is comparatively small. Most engineers prefer to have the width of the horizontal section of the ballast wall on the plane of the bridge seat not less than one-half the distance from base of rail to bridge seat. This may be stated by the formula $W + Db = \frac{D + a}{2}$ in which (see Fig. 1)

W = Width of the ballast wall on top;
D = Distance from the bridge seat to the top of the ballast wall;
a = Distance from the top of the ballast wall to the base of rail;
b = Rate of the frost batter per unit of height.

If this practice is indorsed, ballast walls of abutments for deep deck plate-girders must necessarily be given greater width on top and heavier frost batter on back. The wider the ballast wall and the heavier its frost batter, the further would the earth fall from the bridge seat.

When D is small the problem is comparatively simple: and in fact in many cases a ballast wall of ordinary width with an average frost batter, coupled with slight changes from an ordinary design, is enough to prevent the earth from running on to the bridge seat. This is particularly true in the case of abutment designed for through plate-girders, in which D seldom exceeds 4 ft. Fig. 1 illustrates an abutment of this class. It must be noticed that for through bridges the ballast wall proper is shorter than the bridge seat; so that the earth will start to fall along the side of the abutment at a considerably lower point than it would have done were the ballast wall proper longer than or equal to the bridge seat. Therefore, the excess of the length of the bridge seat over

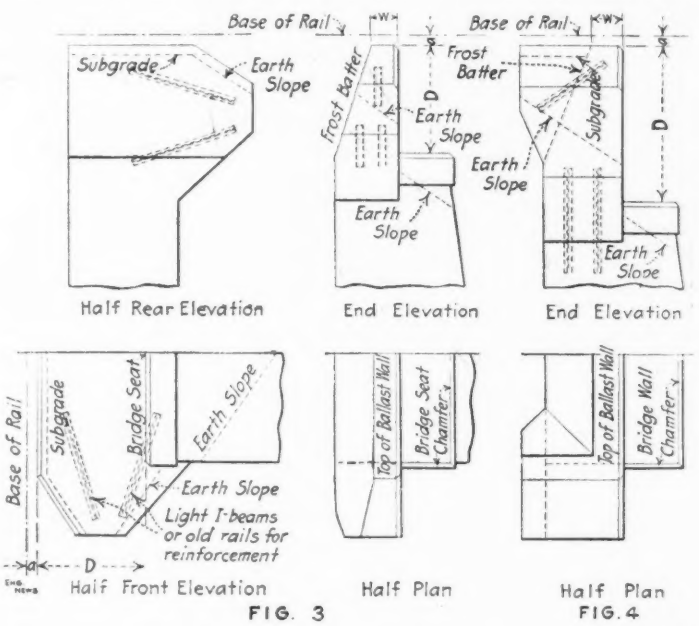


FIG. 3 FIG. 4

that of the ballast wall proper will of necessity, help the matter considerably.

In the case of an abutment for short deck plate-girders, in which D is same as in Fig. 1 but the bridge seat, instead of being longer than the ballast wall, is practically of same length, to attain the desired object the ballast wall is turned at its ends, parallel to the center line of the track, with a battered surface on its back (Fig. 2). In this case the earth begins to fall along the side of the abutment from the level of the subgrade, but at a considerable distance back from the face of the ballast wall.

*Designing Engineer, Mackenzie, Mann & Co., Ltd., Toronto, Can.

In cases for long deck plate-girders, however, in which *D* varies from 7 ft. to 12 ft. or even more, it is difficult to keep the backfill from encroaching on the bridge seat in ordinary abutments, unless short wing walls are provided. Fig. 3 shows an abutment without wing walls,

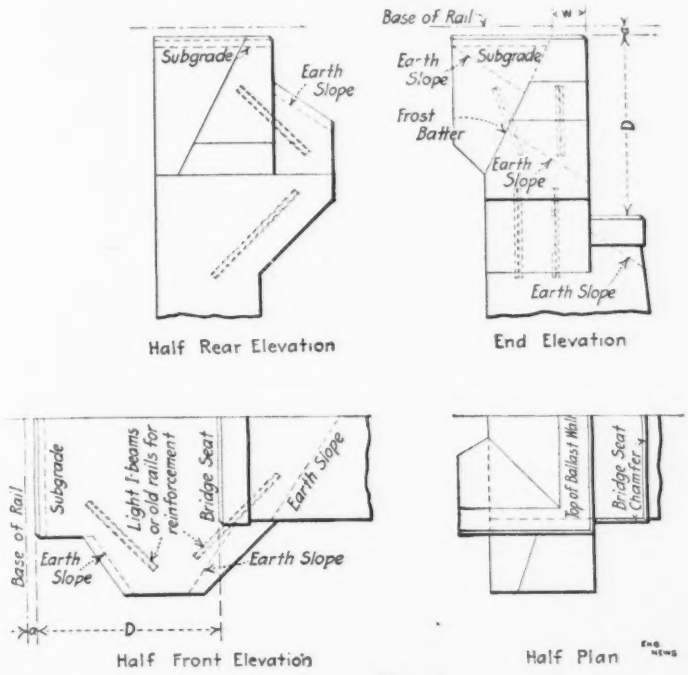


FIG 5

intended for deck plate-girders, suitable for cases in which *D* is about 7 ft. or under. To attain the point in view, the ballast wall proper is extended, following the slope of the backfill, and retaining the frost batter of the ballast wall as well, forming a short cantilever. For lack of better terms, we will call these extensions *lugs*. The earth slopes down along the back and to the end of the lug; then turns along its side at some distance below the subgrade, which is determined by the length of the lug, and the slope of the backfill. These lugs are reinforced with light I-beams or old rails. This type of abutment has been extensively used by the Canadian Northern Ry. on their Eastern Lines and has been found very satisfactory.

For same slope of the backfill, the greater the distance *D*, the longer will the lugs be; so that higher values for *D* call for excessively long lugs, which are, of course, objectionable. But by modifying the ballast wall, or the lug or both, as the case may require, the matter can be considerably simplified. Fig. 4 shows a design in which *D* is about 10 ft. In this case the ballast wall is turned at its ends, parallel to the center line of the track, with a battered surface on the back, and a short lug attached on the front.

Fig. 5 shows another type with some modifications, having nearly 13 ft. for *D*. The ballast wall has been turned and battered on the back, as in the preceding case, while part of the front of the turned portion is vertical. The lug instead of starting from the top of the ballast wall, starts at some distance below, depending upon the slope of the backfill, length of the turned portion of the ballast wall and the frost batter of the lug itself.

In these types the ballast wall proper is taken equal to the width of the subgrade, or roadbed. These cases have been cited to serve as simple examples. Special cases must be given special consideration. It is believed that these abutments can profitably be adopted when conditions warrant having the earth partly cover the breast of the substructure. There is, undoubtedly, considerable saving in concrete, in this design, which would not be feasible where short wings are used.

A design is sometimes used similar to that shown in Fig. 4, except that it has little curtain walls on the sides of the bridge seat, extending from the face of the ballast wall toward the breast of the abutment, and following the earth slope. This design, however, calls for unncessarily long bridge seat, unless the curtain walls are properly reinforced and then projected beyond the sides of the bridge seat. The vertical surface on the bridge seat may also be objected to, on the ground that undesirable material may accumulate between the girder and the adjacent wall, especially when the bridge seat is comparatively short. Furthermore, the girders during erection may hit the thin curtain walls and demolish them.

A Bridge Abutment with Cantilever Wings

A special form of concrete bridge abutment is used in the bridges crossing the Datteln-Hamm Canal, in western Germany, now under construction. The canal passes through a coal-mining region, where the ground practically everywhere is subject to subsidences up to a num-

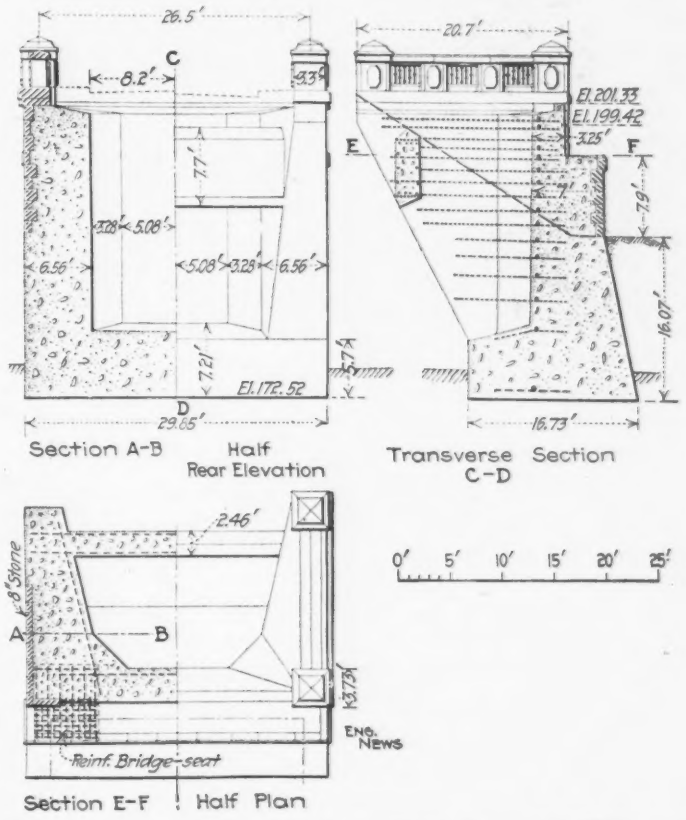


FIG. 1. TYPICAL BRIDGE-ABUTMENT PIER AS USED ON NEW CANAL FROM DATTELN TO HAMM, RHENISH PRUSSIA

ber of feet. While more or less continuous, these subsidences are quite irregular in their distribution along the canal, and also irregular as to time of occurrence. Various special constructions were used in the canal work to provide against injurious or disturbing effect of future

subsidences, and among other items the bridge abutments had to be so designed that they would not be in danger of being broken apart when settlement tends to tilt or shift them. A drawing and some photographic views herewith show the type.

The abutment consists of a pier and two rearward wings, which, however, are cantilevered out from the pier and do not rest on bases of their own. As the danger of injury from settlement is about in proportion to the size of the base of the structure, in this case the abutment was made as small as possible in ground plan, that is to say as compact as the allowable soil pressure and other conditions permitted. The whole abutment is made of reinforced concrete. The upwardly sloping wings, which are parallel to each other and to the center line of bridge, are not retaining walls, but act as beams in retaining the earth, being held by the body of the pier from which they project, and at their outer end by a transverse tie. Their inner faces are vertical, so that wedging action of the earth is avoided. Even without this, the outward pressure from earth load and surcharge is such as to require a very considerable cross-section for the transverse tie. The use of reinforced concrete for this member will be seen to make a substantial construction and obviate all rusting trouble. The top surface of the tie is shaped to a ridge, minimizing the earth pressure on it.

The views show several abutments of this type during construction and after completion. They clearly exhibit the peculiar shape of the abutment and also show how the forms for the concrete work had to be supported under the overhang of the wings.

The exterior or showing faces of these abutments are in general of sandstone, the body being in all cases of concrete. The bridge seats are separately molded reinforced-concrete blocks. Oberbaurat Hermann, of the Königliche Kanalbaudirektion, Essen on Ruhr, is in charge of the canal section to which the illustrations and description pertain.

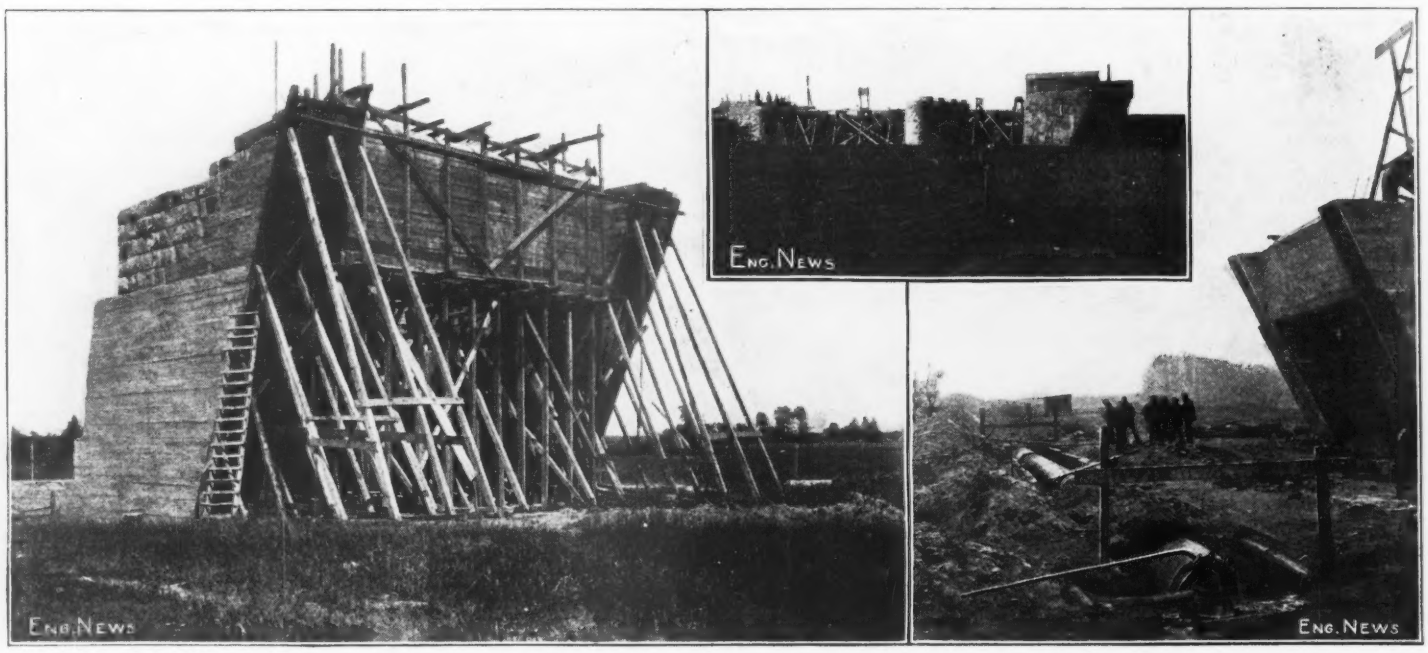


FIG. 2. BOTTOM FORMS STILL IN PLACE FIG. 3. BACK OF ABUTMENT PIER

BRIDGE-ABUTMENT PIER ON DATTELN-HAMM CANAL, GERMANY

Expediting Progress on "Rush" Construction Work*

BY JAMES L. STUART†

In May, 1910, a large manufacturing plant at Pittsburgh, covering approximately 15 acres, was almost totally destroyed by fire. All of the buildings were brick, some with wood trusses and slate roofs, but the greater number were constructed with steel frames and cement tile roofs. The fire in and around these steel structures was so intense that most of them collapsed of their own weight and were but a mass of twisted steel, broken cement tile, brick and mortar, all of which it became necessary to remove in order to reconstruct the plant.

We first received orders to clear the site and subsequently were instructed to proceed with the reconstruction of the buildings. Fortunately, the power plant had not been greatly damaged and we were able to get sufficient current to use in cutting up or burning apart the collapsed steel frames. This steel wreckage was so badly damaged that it was loaded on cars and sold as junk.

After the site was cleared we began excavating for the new foundations, starting on the buildings that would be required first and those in which the greatest amount of machinery was to be installed. This scheme was followed so as to enable the entire plant to be completed at about the same time. It was the desire of the company to commence manufacturing by October, or earlier if possible. The key to this particular situation was to get the steel, of which there was about 4800 tons.

After consultation with the operating and executive departments of the company, the order in which the different buildings were to be completed was decided on. Dates were fixed for the delivery of the steel for each building and were included in the schedule for the completed buildings. The structures were quite simple, similar to most modern factory buildings, but in order to live up to our schedule we knew we must keep continually in touch with the bridge company and see that nothing was permitted to lag or be left undone in order to make the deliveries as they promised.

Our expediter was put in charge of the job at once and during the first month spent most of his time between the order department of the bridge company and the steel mills at which the plain material was being rolled. After the last of the orders for the plain material had been sent to the rolling mills he devoted his time more particularly to the drawing room of the bridge company and reported daily what

*Abstract of a paper in the September number of the "Journal" of the Cleveland Engineering Society.

†Consulting Engineer, Pittsburgh, Penn.

progress was being made in designing, detailing and checking, the number of draftsmen employed, and the progress made on each building.

At times it was found that the checking department was overbalanced by the detailing department, and that the designing department was not turning out sufficient work to keep the draftsmen doing the detailing and the checkers busy. This was adjusted by numerous meetings between the bridge company, the executive department, the manufacturing company and ourselves.

The principal requisites of an expediter are, a thorough knowledge of the work to be performed, a pleasant personality, and the ability to interest the people who are actually doing the work (in this case, the men who made out the mill orders, the draftsmen, the different foremen in charge of the rolling mill and the foremen in the fabricating shop). All should be made to feel that their interests are parallel and that what is good for one is good for all.

As soon as the drawings for one of the buildings were completed, we saw that this work was put in the shop at once, where someone had already seen that the plain material was delivered, and that no time was lost in fabricating and shipping.

At times during the preparation of the drawings it was found necessary to urge the bridge company to employ additional men in all departments. This required considerable tact and force as, naturally, the heads of the different departments do not care to have their routine changed or, as they express it, "meddled with." This phase of the difficulty can be overcome only when it is possible to get sufficient interest aroused in that particular piece of work.

When the work was started, our expediter received from the rolling mills a list of their daily rollings, and we saw to it that certain materials were got in on the dates at which the first rolling of that particular material was made. This saved not a little time and we were able to get all of the plain material delivered before the shop drawings were entirely completed on the first building.

The meetings between the heads of our department and the heads of the bridge company were most useful. Our expediter was usually on hand and we were able to discuss the progress made since the last meeting, the condition of the work in the drafting room and shop, and to devise ways and means for overcoming any obstacles that had arisen either due to lack of men or want of materials.

The steel was erected as fast as the work was got out of the mill, fabricated and delivered. We insisted on its being fabricated in sequence, so that any materials delivered at the building could be immediately put in place. It had been previously decided at which end of the building the work would commence and our superintendent in the field was advised of this fact and was also kept in thorough touch with the progress of the different stages of the steel.

As the cars of steel were loaded and shipped out, they were put in the hands of the tracing department of the manufacturing company and our own tracing department, and shipments were followed up until they were finally landed at the site. Our tracing department had, prior to this time, made the acquaintance of the different employees of the railway through whom the records of the movement of the cars was to pass, as well as those who had direct charge at the transfer points.

After the steel had been delivered the rest of the work was a mere question of brick, mortar, sand, gravel, cement, window frames, sash, roofing material and sufficient workmen. Of course, there were large quantities of all these materials required and in order not to delay the work it was imperative that certain amounts be delivered and put in place prior to the delivery of the steel.

This same method was applied to the construction of the Statler Hotel, at Cleveland, except that the work was much more complicated and required many more details. There were approximately 90 sub-contractors and material men in and around the building from almost the day it was started until its completion, and it required a great deal of patience, perseverance and hard work to get the different trades to dovetail into each other throughout so that those who did the preparatory work would be through and away in time to permit the finish material to be erected.

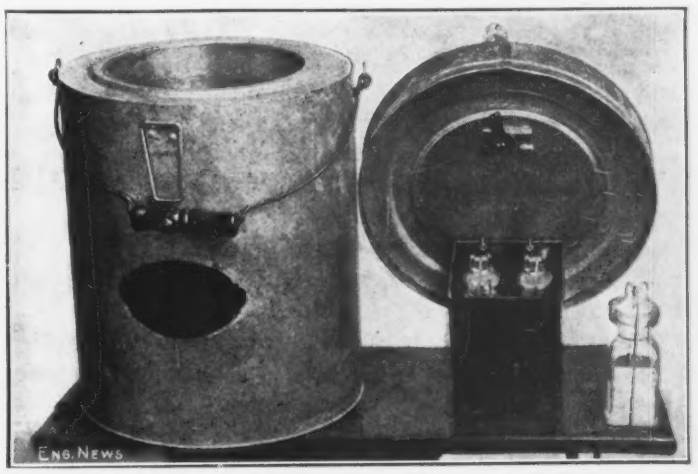
We found it necessary to insist on daily meetings of all of the sub-contractors on the work, together with the architect's representative and others interested in the building. At these daily meetings each trade was taken up separately with the principal representative of that particular trade and the representatives of all the other trades present. He was asked regarding the progress of his work and was told to state whether or not he was being retarded by any of the other trades. If it was found that he was being hampered he was made to state explicitly and in detail to what extent and how.

A New Shipping Outfit for Iced-Water Samples

In shipping water samples for bacterial analysis it is necessary that the water be kept at so low a temperature as to inhibit bacterial growth and also that the bottles containing the samples be protected against breakage. In other words, a combined refrigerator and packing case must be provided, and obviously the weight and bulk must be kept down for convenience in handling and to save transportation charges.

To meet the demands just specified under conditions of long shipping distances and high summer temperatures a shipping outfit has been devised by the Kansas State Water Survey Laboratory which satisfactorily stood the test of the very hot summer of 1913.*

The following description of these outfits, of which 50 are now in use, will be more readily understood by reference to the accompanying view which shows the various parts.



SHIPPING OUTFIT FOR WATER SAMPLES

SAMPLE BOTTLES—Square sample bottles of 6-oz. holding capacity are used. These are further described in the paper as follows:

One face is ground so that the description of the sample can be written on the bottle. The top of the ground space serves as a graduation for 4 oz. of water, thus allowing for an air space above the sample. The stoppers and bottles are numbered and each stopper is ground to fit.

The special feature of this bottle is the design of the stopper. The stopper proper is partially protected by an overhanging hood. The hood, however, has for its chief purpose the protection of the neck of the bottle. The handle is notched to hold a strong rubber band and is heavy enough so that if the stopper is laid down, the portions coming in contact with the water will be held away from the surface on which the stopper is placed.

Twelve dozen of these bottles have been in use three months. In that time only six have been broken in sterilizing, two in shipment and four in collecting samples. In practice the bottles are washed with chromic-acid cleaning mixture, rinsed, dried, and then sterilized in a dry oven at 180° to 200° C. for an hour.

BOX FOR HOLDING SAMPLE BOTTLES—The bottles are placed in a copper container, rectangular in plan, provided with a movable partition so that either 1, 2, 3 or 4 bottles can be carried.

*Based on a paper describing the outfit read on Sept. 11, 1913, before the Laboratory Section of the American Public Health Association, at Colorado Springs, Colo., by Frederick H. Billings, professor of bacteriology, and C. C. Young, director State Water Survey, University of Kansas, Lawrence, Kan. The paper will be published in the "Journal" of the Association.

Refrigerator Case—For holding ice and insulating and protecting the container and its samples a case of pressed ground cork, molded in one piece, protected on the outside with No. 28 galvanized iron and on the inside with 8-oz. tinned copper, seamed and soldered, is used, the whole provided with a clamped cover and a bail to make a handy shipping case. This refrigerator is 12 in. in diameter and 16 in. high, outside, 8 in. in diameter and 12 in. deep, inside, and weighs 17 lb. when empty. Packed for shipment with four samples in their copper box, and with ice, the outfit weighs 24 lb., thus coming under the 30c. limit of "express tariff K."

The copper box containing the bottles is hung from the lid of the refrigerator by two hooks and a catch, which brings the box snug up to the under side of the lid and leaves space below the copper box, in the refrigerator case, for 6 or 7 lb. of ice. Once the catch is closed and the lid fastened in place, it is impossible for the catch to come unfastened until the lid is removed.

Should the whole outfit be tipped over during shipment the arrangement described prevents the melted ice from coming in contact with the sample bottles.

It was found on trial in a 37° C. incubator that 6 lb. of ice would keep water samples placed in this refrigerator below 10° for 34 to 36 hours, "depending upon the size of the pieces of ice used in packing."

Results—Of about fifty shipments to the laboratory by the state sanitary engineer and members of the Survey staff, all arrived with the samples below 10° C. Of 104 shipments by county health officers, city engineers and water-works superintendents, most of these men never having used the outfit before, all but ten outfits reached the laboratory with samples below 10° C., 60 still contained some of the ice used in the original packing and of 34 without ice all were under 10° C. Of the ten outfits received in poor condition 8 were en route 48 hr. or more and two, which were on the road only 36 hr., showed, by the amount of water in the ice space, that they had not been properly packed.

A table showing for the 104 shipments the distance shipped, transfers en route, hours en route, maximum temperature at Lawrence and condition on arrival seems to bear out the conclusion of the authors that "when properly iced this container will keep samples under 10° [C] for 36 hr. in the hottest weather."

All but some thirty of the shipments were from distances of more than 100 miles and nearly thirty were from distances of more than 200 miles. More than 50 of the shipments were received at Lawrence on days when the thermometer registered a maximum of from 100 to 105° F. and about 80 shipments came in under maximum temperatures of more than 90° F.

The shipping cases were made by the 3-H. Mfg. Co., Lawrence, Kan., and the bottles were supplied by Bausch & Lomb, Rochester, N. Y.

Rules for Laying Up Idle Equipment

Machinery used on the Panama Canal, which is now being retired from service, is to be handled according to rules published in an official circular dated Sept. 12 and published in the *Canal Record* Sept. 24. We reprint the rules below, as they are just as useful for general contract equipment as for the Panama Canal machinery.

Locomotives—Boilers should be emptied and thoroughly cleaned of all scale and foreign matter. Boiler should then be filled with water, leaving space enough for at least two barrels of crude oil or a sufficient amount of crude oil to cover the internal surfaces of boiler and tubes. This oil should be put in at dome, then blow-off cock should be opened up and boiler drained. The same instructions apply to locomotive tanks as to boilers. The front end of locomotives and fireboxes of all boilers should be thoroughly cleaned and brushed off with wire brush and given a coat of tar paint. This paint can be put on with a spray. The coal space on all locomotive tanks should be thoroughly cleaned and scaled and surface given a coat of tar paint. All exterior surfaces of equipment should be painted if necessary, using the standard grade of paint which is commonly used for that purpose. The jackets on all boilers should be given a coat of white lead and tallow. Smoke stacks should be covered with sheet-iron covering made specially for this purpose. Main rods of locomotives should be disconnected and all bearing and bright surfaces receive a coat of white lead and tallow. Eccentric straps and blades should be removed from locomotives and placed with main rods in the cabs, and cabs boarded up. The steam chest cover should be lifted, cylinder heads removed, and all surfaces treated with a coating of white lead and tallow. It will be necessary to remove the valves and pull pistons in order to get at the parts, which should be replaced, steam chest and cylinders closed, and the crossheads blocked in order to eliminate the moving of the pistons in cylinders. The air pumps and the feed pumps on all equipment should be opened up and surfaces treated with a coat of white lead and tallow. The cap on engineer's brake valve on locomotives should be lifted and the surfaces of the valves, etc., slushed with vaseline. All exterior surfaces of cab fittings should be given either a coat of white lead and tallow or vaseline. Interior surfaces of triple valves and injectors need not be treated, as they are brass. Journal box cellars on all drivers and engine truck wheels should be well packed, also journal boxes on tanks.

Steamshovels—The same general rules for the care of locomotives will apply to steamshovels. All engine pistons, valves, rods, eccentric straps, "A" frame collar and swing circle to be removed; shafts lifted from bearings, wearing surfaces cleaned, doped with white lead and replaced. Boilers should be stripped with lagging, and cleaned as outlined for locomotive boilers. Water tanks should be taken off shovels, inspected, and if found in bad condition they should be scrapped. Roofs should be painted with tar paint; also coal platforms and dippers. Other parts now covered with oil or grease can be protected with a coat of crude oil, which will be sufficient protection.

Unloaders, Cranes, Spreaders, Hoisting Engines, Trackshifters and Piledrivers—Machinery should be gone over and given a coat of white lead and tallow, as outlined for steamshovels.

Miscellaneous Machinery, including Shop's Machinery and Tools—Air pumps and feed pumps on all equipment should be opened up and surfaces treated with a coating of white lead and tallow. All bearings, journals and bright surfaces of all machinery and equipment should be given a coat of white lead and tallow.

Intersecting Circular Curves with Non-Parallel Tangents: A Theorem

By W. R. Horn*

An article on "A Special Problem in Reverse Curves," by Wm. C. Crosby, appeared in Engineering News of June 26, 1913 (p. 1322). It may interest the writer of that article and perhaps some others to know that the construction there shown is a particular case of a more general geometrical theorem which is applicable to a wide range of problems involving circular curves.

Theorem—If AC and BC, Fig. 1, be two given straight lines intersecting at an angle δ, and arcs of circles AP, BP be drawn touching these lines at A and B, and intersecting in P at an angle α, then

$$Angle\ A\,P\,B = \tfrac{1}{2}\,(\alpha + \delta)$$

and therefore the locus of point P for all arcs intersect-

*Executive Engineer, Indian State Railways, Madras, India.

ing at the same angle a is a circle passing through A and B, whose radius is $\frac{AB}{2\ sin\ \frac{1}{2}\ (a + \delta)}$.

A particular case of this theorem in which the center of the arc BP lies on AB produced, is given in a paper by Preston & Barnard in "Proceedings of the Institution of Civil Engineers," Vol. CXLV, in which it is applied to the theory of railway turnouts laid with curves tangential to the switches. I may add that the general theorem suggested itself to me after a perusal of this paper.

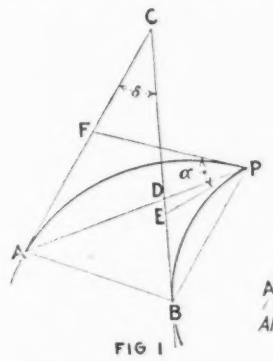


FIG. 1

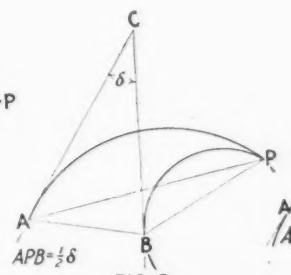


FIG. 2

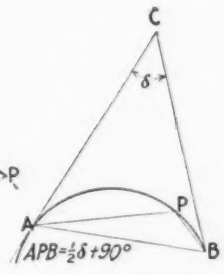


FIG. 3

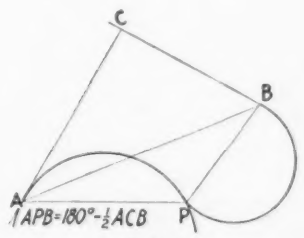


FIG. 4

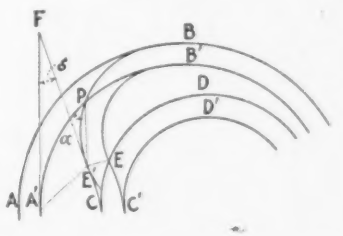


FIG. 5

Eng. News

Proof—In Fig. 1, BE and PE are tangents to the arc BP; AF and PF are tangents to the arc AP. The angle EPF is a, the angle of intersection of the arcs. In the triangles $ACD + DPB$, $\angle$s ADC and BDP are equal. Hence,

$$\angle\ ACD + \angle\ CAD = \angle\ DPB + \angle\ DBP$$

But since AF and PF are tangents to the arc AP,

$$\angle\ CAD = \angle\ FPA$$

Similarly,

$$\angle\ DBP = \angle\ EPB$$

Therefore we have

$$\delta + \angle\ FPA = \angle\ APB + \angle\ EPB$$

that is

$$\delta + FPB - APB = APB + EPB$$

Therefore,

$$2 \angle\ APB = \delta + FPB - EPB = \delta + a$$

$$APB = \tfrac{1}{2}\ (a + \delta)$$

which proves the proposition.

Special Cases—The theorem will hold whatever may be the value of the angle a, and will therefore hold when the two arcs are tangent. In Figs. 2 and 3, two such cases are shown; in Fig. 2, a = zero, while in Fig. 3, a = two right angles.

The case given by Mr. Crosby is shown in Fig. 4. In this case since the curves are reverse, the angle δ must be taken as the supplement of the angle ACB, that is as $180° - ACB$, and $a = 180°$. The angle APB will, therefore, be $\frac{1}{2}\ (360° - ACB)$, that is, $180° - \frac{1}{2}\ ACB$. In all these cases (Figs. 2, 3 and 4), it is clear that the center of the circular locus of P lies on the circumference of the circle circumscribing the $\triangle\ ABC$.

The importance of the theorem in the theory of railway turnouts is well shown in the paper (referred to above) of Preston & Barnard, and I shall conclude by showing how it is to be applied to the general case of a crossover, which case was not treated by them.

Application to a Crossover—In Fig. 5, let AB, $A'B'$ and CD, $C'D'$, be any two curved tracks (which need not be, and are therefore not shown as concentric), and suppose it is desired to connect these tracks by a crossover with frog angles β on CD and a on $A'B'$. Let E be the position of the frog on CD, and let E' be the point on the other rail of the turnout, directly opposite to E. Let $E'F$ be the tangent at E' to the curve CE'. The problem then is: to find the position P on the rail $A'B'$ of a frog of angle a, such that a circular curve may lie evenly between it and the tangent $E'F$.

Take any point A' on the rail $A'B'$, and let $A'F$ be the tangent at A'. Measure the angle $A'FE'$, and call it δ. Then by the theorem, the position of the crossing P will be at the intersection of the rail $A'B'$ with the circumference of a circle of radius $\frac{\frac{1}{2}\ A'E'}{sin\ \frac{1}{2}\ (a + \delta)}$, described to pass through $A' + E'$. Having thus found the position of P, the crossover may be run by the ordinary methods.

This will, of course, afford a solution of the case of a crossover between two parallel curved tracks, dealt with in an article by R. W. Stewart in Engineering News of May 22, 1913, (p. 1068).

Templates for Embankment Slopes

By M. D. Ewell*

During the building of and repairs on a dike along the Oswego River, I worked out and used the following devices in locating embankment lines. I found these homemade instruments to be sufficiently accurate and a great saving of time.

Fig. 1 illustrates the template used in building the slope originally. It was made from 1x2-in. pine strips nailed in the form shown. The hypotenuse or grading side was about 8 ft. long, and when in use was located in the proper position by setting the base of the templet on on the top of the slope stake, which had been previously set in the usual manner except that the top of the stake instead of the base intersected the slope. The proper slope for the template was shown by means of a plumb line attached to the upper brace, falling across a mark on the lower one. This instrument was placed in the hands of the inspector and used by him from time to time to check the outline of the embankment. When the bank was built up to nearly the limit of the template a new stake was set under the upper end, and the template raised to this position.

After some time it was found, in this particular case, that the slope had been built too steep to stand properly,

*Assistant Engineer, New York State Canals, Oswego Canal, Fulton, N. Y.

and it was decided to make repairs by narrowing the top and flattening the slope. For this work I devised the template shown in Fig. 2; it was made of strips as before, in the form of a truss 16 ft. between supports. Each support was made adjustable in length, by means of clamps at *A* and *B*, and graduated in feet and tenths from zero to 4 ft., from the bottom up. The lower chord was also graduated in feet and tenths from zero to 16 ft. In use the stake at *E* was set with its top on the line and grade of the shoulder of the embankment. The template was then placed in the position shown, with the uphill leg on the top of the stake *E*. Clamp *A* was then set so that *AE* equaled 2 ft. The lower chord was then brought parallel to the finished slope as indicated by a plumb line supported at *F*, falling across a mark on the lower chord. The template was held in this position by the lower leg and clamp at *B*. In this position sections for final estimate were taken with a small rod held normal to the lower chord, distances being read directly on the lower chord. A rod

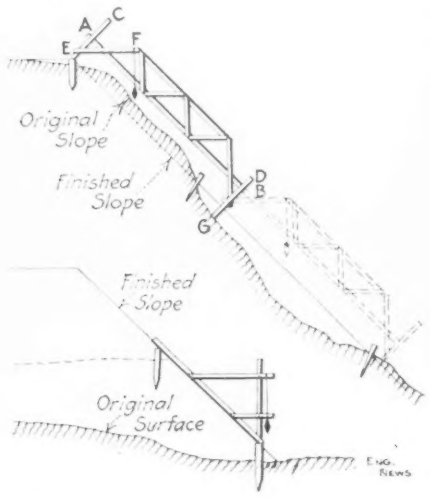


FIG. 2. (ABOVE) TEMPLATE FOR TRIMMING BANK
FIG. 1. (BELOW) TEMPLATE FOR BUILDING BANK

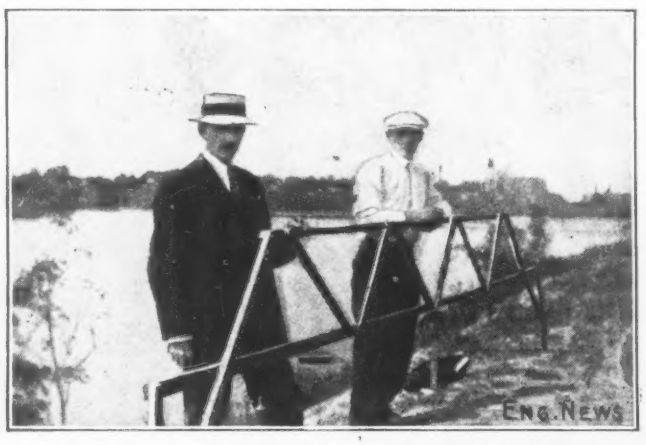


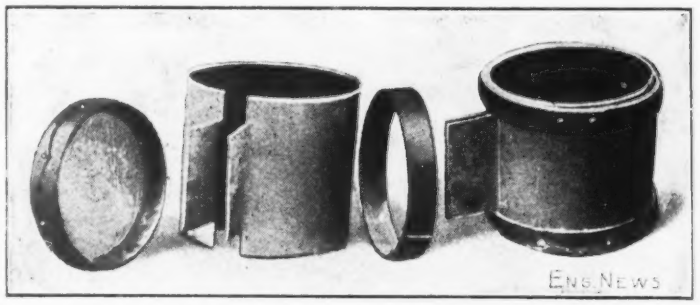
FIG. 3. TEMPLATES FOR SETTING TRIMMING STAKES ON EMBANKMENT SLOPES, OSWEGO CANAL

of less than 2 ft. indicated *Cut;* of just 2 ft., the position for a slope stake; of more than 2 ft., *Fill*. The template was then moved down the hill until the upper leg stood in the same position and at the same reading the lower one previously stood. The process was then repeated as many times as necessary to reach the bottom of the slope.

NOTES

A Mold for Field Samples of Concrete, designed by C. V. Mann while engineer in charge on the Albion masonry dam for Boulder, Colo., is shown in the small view herewith. It proved very convenient and useful for taking samples, both those intended for crushing in the testing machine and those wanted for record samples and the like. Samples were taken as the concrete came from the mixer to go into the dam, and most of them were later broken with a hammer for examination of structure, toughness, etc.

The mold is made of No. 18 galvanized iron. The cylinder is split and has outward-projecting lug portions at the joint,



MOLD FOR FIELD SAMPLES OF CONCRETE, 6x6-IN. CYLINDERS
(Used by C. V. Mann on Albion Dam.)

which are a help in slipping on the top and bottom rings of the mold and further serve to make a tight joint up the side. The top and bottom rings (the latter having the mold bottom riveted to it) are of 1x⅛-in. iron. Both rings slip over the mold cylinder, fitting it snugly, and are readily knocked off when the sample has set by tapping with a hammer. The mold is 6 in. in diameter and 6 in. long.

Breaking Quarry Stone with a Cannon Ball—In breaking up masses of blasted rock at a quarry for use in the cyclopean masonry of the Farnham dam of the additional water-supply system of Pittsfield, Mass., the contractor, MacArthur Bros. & Winston, rigged up the device illustrated in the accompanying photograph. The ball was of cast iron and weighed about 3000 lb. A jerk of a cord released it from a

hook attached by wire rope to the derrick-boom. The rapidity and efficiency of its operation evidently depends largely on the operator and the circumstances, but we have been informed that these contractors have made use of the device on several occasions. [Photograph and data from Hiram Allen Miller, Consulting Engineer, Boston, Mass., under whose supervision the new water-works were constructed.]

The Graphical Method of Dividing the Neutral Axis in concrete arch design described in an article by T. A. Smith in our issue of September 25, 1913, p. 611, is also to be found in the chapter on arches by Prof. Frank T. McKibben in

Taylor & Thompson's "A Treatise on Concrete, Plain and Reinforced," p. 554. That the method had previously appeared in the literature of the subject escaped the memory of the editor in preparing Mr. Smith's article.

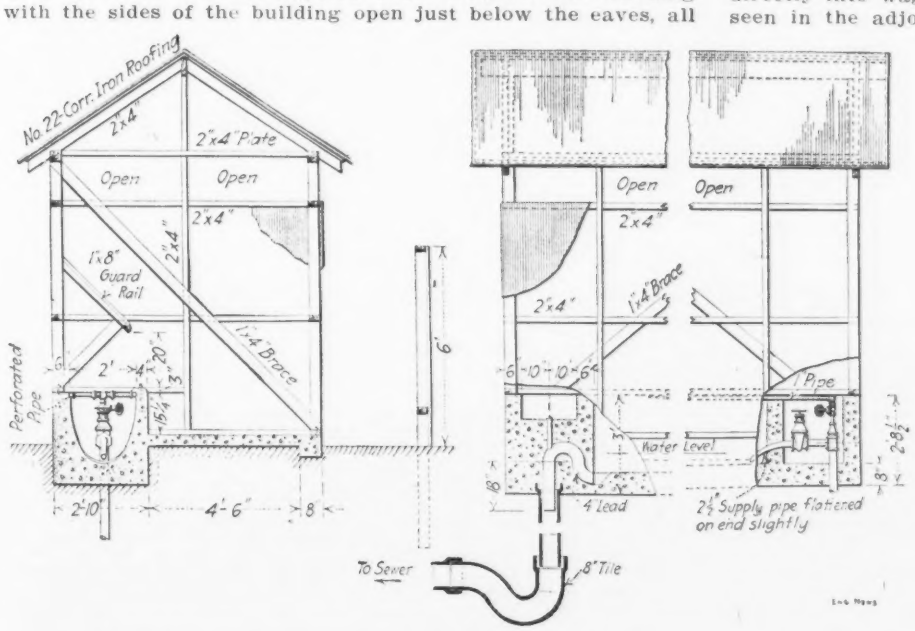
Fountain Drawing Pen—Our mention of a fountain drawing pen (Sept. 25, 1913, p. 614) leads Virgil A. Eberly, New Orleans, to tell of two years' favorable experience with another fountain drawing pen, a Riefler pen bought at Culebra, Canal Zone. He says:

> I am certainly surprised that your draftsmen do not know of it and use it. The application of the ink is by screwing the piston into the hollow handle or barrel, which forces the ink through a tube between the nibs. The size of the tube is large enough to insert a ramrod (furnished with the pen) to clean out any dried ink. The pen thus does not depend on natural flow, which is always uncertain with a quickly drying ink. Besides, the amount of ink between the nibs can be varied to any desired quantity at will. I would consider a draftsman somewhat slow who does not know of Riefler's pen. I paid only $1.25 or $1.50 for this pen, as I did not have to pay any duty.

We understand that the American price of similar pens is $3 or $3.50.

Cost Data on Blueprinting—Referring to an article on this subject in our issue of Sept. 25, p. 612, we are informed by the manufacturers of the blueprinting machine mentioned, the Revolute Machine Co., New York, that two of the expense figures charged to the machine are in error: The cost of replacing the lamps (stated in the article as $16) should be $32; the cost of a new glass cylinder (stated as $75) should be $65.

A Simple Latrine has been designed for the new smelter plant of the United Verde Copper Co., at Clarkdale, Ariz. Its two distinguishing features are (1) the use of concrete for the trough and floor of the latrine and (2) a light wood frame covered with corrugated sheet iron for the building with the sides of the building open just below the eaves, all



LATRINE FOR UNITED VERDE COPPER CO., CLARKDALE, ARIZ.

as shown by the accompanying sections. The latrine is about 8x20 ft. in plan, and, like the smelting plant as a whole, was designed by Repath & McGregor. The front wall of the latrine is surmounted by a 2x6-in. plank, rounded and polished, fastened to the concrete by ½-in. hook bolts. Almost directly over this seat and 20 in. higher is a back rest, which at the same time serves to guard against improper use of the seat. Water is constantly kept in the bottom of the trough, the desired ordinary water level being maintained by the lead trap shown in the longitudinal section. The water-supply to the trough is controlled by a valve. The sides of the trough are kept wet and clean by continuous sprays from perforated 1-in. pipe extending along the top of either side of the trough. The latrine will discharge into the general sewerage system, the sewage from which will go to a septic tank. We are indebted to "The Engineering and Mining Journal" for the original from which our illustration was prepared as well as for the text on which this note is based. We may add that both the latrine proper and the building which covers it are better suited to an Arizona climate than to one very much colder, and that the open sides just beneath the eaves would not be tolerable where heavy wind-driven rains may come almost any day.

Handling Cellar Excavation with a Conveyor—Improved methods in excavating were practised in preparing the site for an addition to the buildings of the Deutsche Bank, Berlin, Germany. This site is on the west side of Mauer St. opposite the two buildings now occupied by the bank. A bucket conveyor was set up on one side of the site, extending from

HANDLING FOUNDATION EXCAVATION WITH A CONVEYOR, BERLIN, GERMANY

near the rear of the lot to a belt conveyor on the sidewalk at the front. The dirt was shoveled directly to this conveyor and the material was discharged from the apron at the street directly into wagons. The arrangement at the street can be seen in the adjoining view. The apron or chute is double, so that either or both of two wagons can be filled. The general contract for the building is held by Boswau & Knauer, but the excavation was sublet to the Metropol Ausschachtgesellschaft, who have patents on the conveyor machinery and make a separate business of excavation.

❖

A Shear and Rivet Diagram for Railway Plate-Girders

In detailing plate-girders, shear calculations and determination of flange-rivet spacing are facilitated by the diagram reproduced below. It was made by Joseph Jacobs, Seattle, Wash., 11 years ago.* This diagram, together with one connecting flange area, depth and span, covers practically all main calculations required for railway plate-girders.

The diagram shown was computed for the Southern Pacific Co. specifications of July 1, 1900. These limit rivet bearing to 16,000 lb. per sq.in. on projected surface. Shear is limited to 9000 lb. per sq.in., but does not enter into the diagram, as bearing has been assumed to govern. For shallow, thick girder-webs, double shear may govern, and such cases must be computed independently.

A diagram like this can be constructed for any other loading (changing only the shear curves, at the right), or for any other value of bearing unit-stress (changing only the rivet-spacing scales).

*A diagram somewhat similar to that by G. D. Fish was published in our issue of Apr. 24, 1913. Mr. Jacobs' diagram is handier for shear and rivet computations, besides being ten years older.

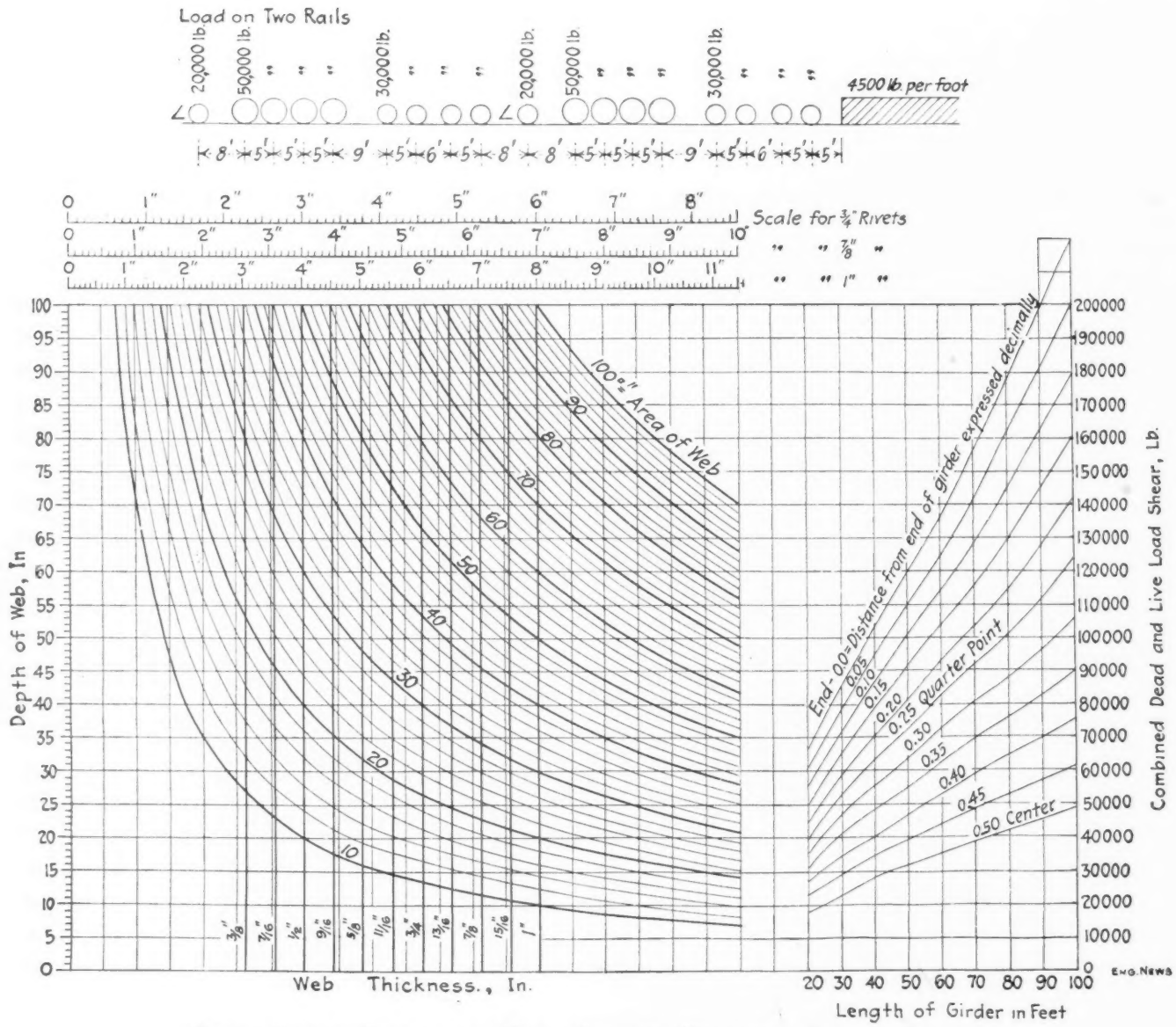

Load on Two Rails
20,000 lb.
50,000 lb.
30,000 lb.
20,000 lb.
50,000 lb.
30,000 lb.
4500 lb. per foot
8' 5' 5' 5' 9' 5' 6' 5' 8' 8' 5' 5' 5' 9' 5' 6' 5' 5'
Scale for ¾" Rivets
Depth of Web, In
100" Area of Web
Web Thickness., In.
End-0.0=Distance from end of girder expressed decimally
0.25 Quarter Point
0.50 Center
Combined Dead and Live Load Shear, Lb.
Length of Girder in Feet
ENG. NEWS

PLATE-GIRDER SHEAR AND RIVET-SPACING DIAGRAM—JOSEPH JACOBS

Loading: Southern Pacific Co. Loading of 1900 specifications; nearly equivalent to Cooper's E-50 loading.

Stresses: Rivet shear 9000 lb. per sq.in.
Rivet bearing, 16,000 lb. per sq.in.
(Rivet spacing based on bearing.)

1. **Vertical Shear**—Curves at right give total **dead plus live shear** at any point along the girder, for girders 20 to 100 ft. in span.
2. **Area of Web**—Hyperbolic curves at left give area of web, for given thickness (read below) and depth (read at left).
3. **Flange Rivet Spacing**—To find the rivet spacing at a given point of the girder: Read the shear from curves at right. Depth and thickness of web being known, locate the curve of area of web (as in 2, using depth between rivet rows), and follow along this curve to the horizontal denoting the shear, as just found. Vertically above this intersection read on upper scale the required rivet spacing.
4. **Limiting Position of Any Rivet Pitch**—Locate curve of web area (using depth between rivet rows). Follow along this curve to intersection with vertical denoting the given rivet pitch. From here follow horizontally to the shear diagram, and intersect the vertical denoting span. The inclined curve at this intersection denotes the position along the girder where the given spacing reaches its limit.
5. **Web Thickness for Minimum Rivet-Pitch**—Intersect the vertical denoting minimum permissible rivet pitch with the horizontal denoting **end shear;** the area curve at this intersection, followed to the horizontal denoting **depth between rivet rows** gives the vertical denoting the required web thickness.
   Where the maximum web thickness is limited, the procedure (5) can be used to find minimum depth of web.

NOTE: The diagram gives theoretical limiting values. Details of construction, shop practice, etc., may require these values to be modified.

Equivalent Uniform Loads on Bridges for Different Types of Engine

In bridge designing, the conventionalized wheel-loads known as Cooper's loadings are used very extensively, though heavy types of locomotive differ materially from the Cooper arrangement. The designer, therefore, must know how various engines in common use compare, in regard to stresses produced. This information is given in very useful form by three diagrams prepared by C. D. Purdon, Chief Engineer, St. Louis Southwestern Ry. Co., St. Louis, Mo.

The diagrams Figs. 1 and 2 are drawn with span lengths as abscissas, and equivalent uniform loads as ordinates. Ten actual engines and three Cooper loadings (E55, E60, E65) are represented, each by a curve. Fig. 1 is based on end shear; Fig. 2 on bending moment.

To prepare these curves, engines of various types were selected, on the basis of 55,000-lb. *average driving-axle load.* The train-loading behind the engine was taken as 5500 lb. per lin.ft. track (one-tenth the average driving-axle load), so that the basis of both engine and train selection would correspond to Cooper's E55 loading.

The wheel diagrams of the various engines used are sketched above the diagrams.

The two diagrams are summarized in Fig. 3, where the ordinates are the Cooper equivalents, abscissas again being lengths of span. Since the Cooper loading which corresponds to a given engine loading at a particular span length is different for moment and for shear, the two values were taken from Fig. 1 and Fig. 2, and the higher one used for Fig. 3.

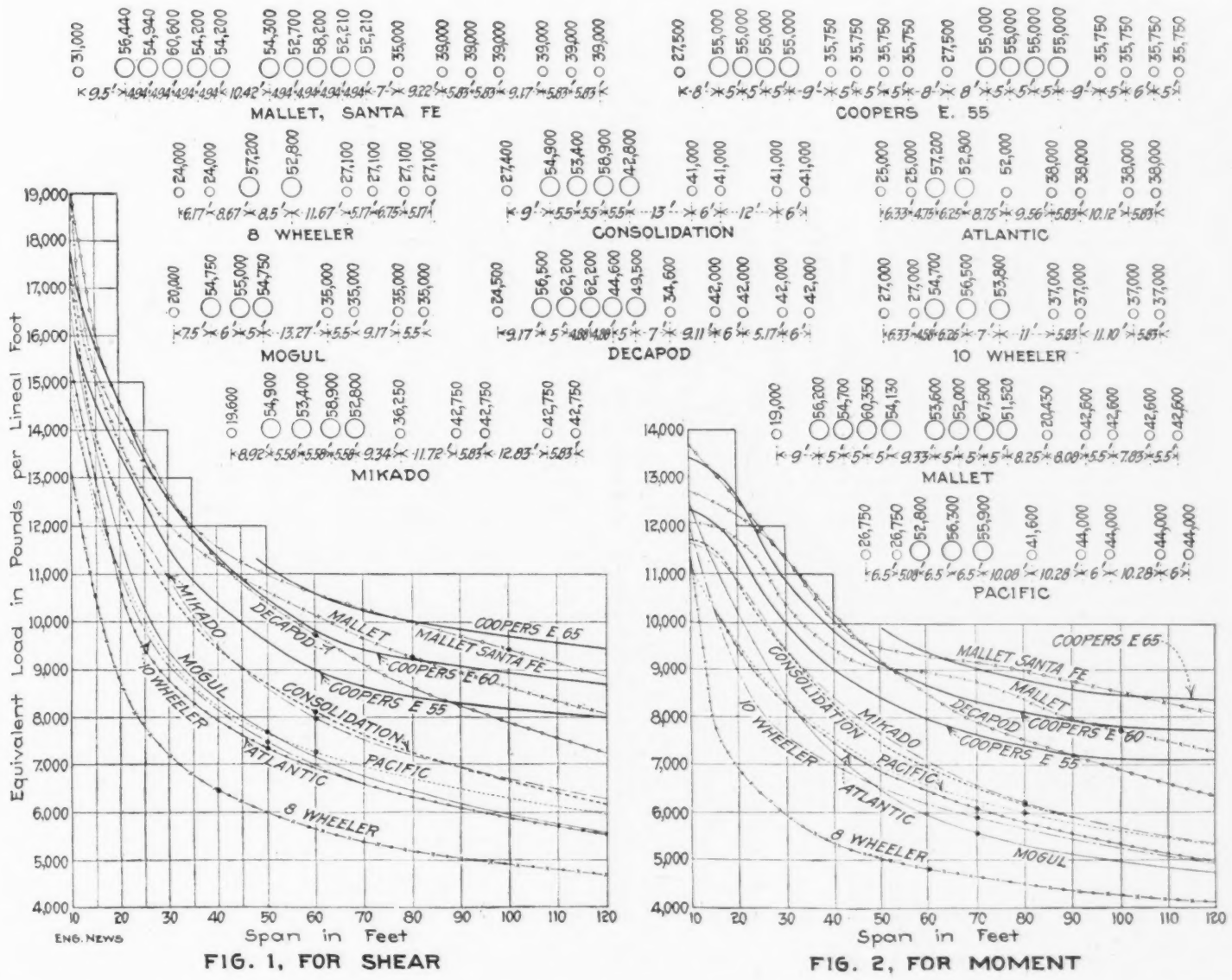


FIG. 1, FOR SHEAR

FIG. 2, FOR MOMENT

FIGS. 1 AND 2. EQUIVALENT UNIFORM LOADS FOR SHEAR AND MOMENT, 10 ENGINES OF 55,000-LB. BASE AND THREE COOPER LOADINGS

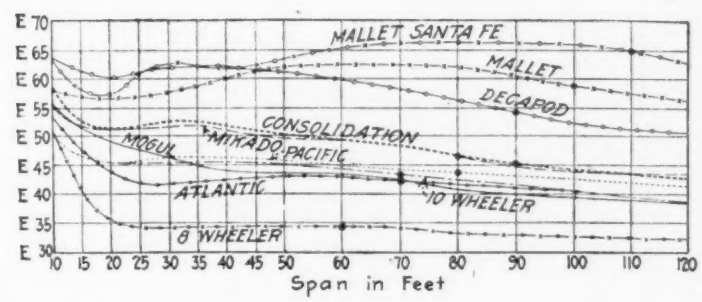


FIG. 3. COOPER EQUIVALENTS OF 10 ENGINES OF 55,000-LB. BASE

A Convenient Earthwork Table

BY PHILIP B. HILL*

A great many earthwork tables have been published, but a careful search has failed to reveal a table just like the one accompanying this article. The table and the figures illustrating its use are self-explanatory. By means of the table the yardage for level cuts and fills may be obtained very quickly.

*Of Lund & Hill, Consulting Engineers, Little Rock, Ark.

The quantities have been carried out to 100ths in order that the quantities may be estimated closer than the nearest cu.yd. if so desired. Most tables of this character give quantities to the nearest cu.yd. only. [The part of the table 1 to 1.9 ft. has been omitted for want of space, but the quantities may be quickly supplied by taking one-half the corresponding quantities for 2 to 3 ft. in the "width of base" column and ¼ the quantities in the "slopes" column.]

16' BASE, 1:1 SLOPES, 7.6' CUT OR FILL

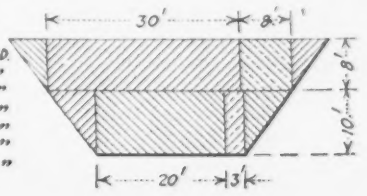
10' PRISM	CONTAINS	281.5	CU. YD.
6' "	"	168.9	" "
SLOPES	"	213.9	" "
	TOTAL	664.3	" "

53' BASE, ½:1 SLOPES, 5.2' CUT OR FILL

50' PRISM	CONTAINS	963.0	CU. YD.
3' "	"	57.8	" "
SLOPES	"	50.1	" "
	TOTAL	1070.9	" "

23' BASE, ¾:1 SLOPES, 18' CUT OR FILL

20' PRISM,	10'	DEEP	CONTAINS	740.7 CU. YD.
3' "	"	"	"	111.1 " "
SLOPES	"	"	"	277.8 " "
30' PRISM	8'	"	"	888.9 " "
8' "	"	"	"	237.0 " "
SLOPES	"	"	"	177.8 " "
			TOTAL	2433.3 " "



EARTHWORK TABLE—CUBIC YARDS PER 100 FEET, LEVEL SURFACE

Depth of cut or height of fill	Width of base or crown								Slopes						Depth of cut or height of fill
	1	2	3	4	5	6	7	8	9	½ : 1	¾ : 1	1 : 1	1½ : 1	2 : 1	3 : 1	
2.0	7.41	14.81	22.22	29.63	37.04	44.44	51.85	59.26	66.67	7.41	11.11	14.81	22.22	29.63	44.44	2.0
2.1	7.78	15.56	23.33	31.11	38.89	46.67	54.44	62.22	70.00	8.17	12.25	16.33	24.50	32.67	49.00	2.1
2.2	8.15	16.30	24.44	32.59	40.74	48.89	57.04	65.19	73.33	8.96	13.44	17.93	26.89	35.85	53.78	2.2
2.3	8.52	17.04	25.56	34.07	42.59	51.11	59.63	68.15	76.67	9.79	14.69	19.59	29.39	39.19	58.78	2.3
2.4	8.89	17.78	26.67	35.56	44.44	53.33	62.22	71.11	80.00	10.67	16.00	21.33	32.00	42.67	64.00	2.4
2.5	9.26	18.52	27.78	37.04	46.30	55.56	64.81	74.07	83.33	11.58	17.36	23.15	34.72	46.30	69.44	2.5
2.6	9.63	19.26	28.89	38.52	48.15	57.78	67.41	77.04	86.67	12.52	18.78	25.04	37.56	50.07	75.11	2.6
2.7	10.00	20.00	30.00	40.00	50.00	60.00	70.00	80.00	90.00	13.50	20.25	27.00	40.50	54.00	81.00	2.7
2.8	10.37	20.74	31.11	41.48	51.85	62.22	72.59	82.96	93.33	14.52	21.78	29.04	43.56	58.07	87.11	2.8
2.9	10.74	21.48	32.22	42.96	53.70	64.44	85.19	85.93	96.67	15.58	23.36	31.15	46.72	62.30	93.44	2.9
3.0	11.11	22.22	33.33	44.44	55.56	66.67	77.78	88.89	100.00	16.67	25.00	33.33	50.00	66.67	100.00	3.0
3.1	11.58	22.96	34.44	45.93	57.41	68.89	80.37	91.85	103.33	17.79	26.69	35.59	53.39	71.19	106.78	3.1
3.2	11.85	23.70	35.56	47.41	59.26	71.11	82.96	94.81	106.67	18.96	28.44	37.93	56.89	75.85	113.78	3.2
3.3	12.22	24.44	36.67	48.89	61.11	73.33	85.56	97.78	110.00	20.17	30.25	40.33	60.50	80.67	121.00	3.3
3.4	12.59	25.19	37.78	50.37	62.96	75.56	88.15	100.74	113.33	21.41	32.11	42.81	64.22	85.63	128.44	3.4
3.5	12.96	25.93	38.89	51.85	64.81	77.78	90.74	103.70	116.67	22.69	34.03	45.37	68.05	90.74	136.11	3.5
3.6	13.33	26.67	40.00	53.33	66.67	80.00	93.33	106.67	120.00	24.00	36.00	48.00	72.00	96.00	144.00	3.6
3.7	13.70	27.41	41.11	54.81	68.52	82.22	95.93	109.63	123.33	25.35	38.03	50.70	76.05	101.41	152.11	3.7
3.8	14.07	28.15	42.22	56.30	70.37	84.44	98.52	112.59	126.67	26.74	40.11	53.48	80.22	106.96	160.44	3.8
3.9	14.44	28.89	43.33	57.78	72.22	86.67	101.11	115.56	130.00	28.17	42.25	56.33	84.50	112.67	169.00	3.9
4.0	14.81	29.63	44.44	59.26	74.07	88.89	103.70	118.52	133.33	29.63	44.44	59.26	88.89	118.52	177.78	4.0
4.1	15.19	30.37	45.56	60.74	75.93	91.11	106.30	121.48	136.67	31.13	46.69	62.26	93.39	124.52	186.78	4.1
4.2	15.56	31.11	46.67	62.22	77.78	93.33	108.89	124.44	140.00	32.67	49.00	65.33	98.00	130.67	196.00	4.2
4.3	15.93	31.85	47.78	63.70	79.63	95.56	111.48	127.41	143.33	34.24	51.36	68.48	102.72	136.96	205.44	4.3
4.4	16.30	32.59	48.89	65.19	81.48	97.78	114.07	130.37	146.67	35.85	53.78	71.70	107.56	143.41	215.11	4.4
4.5	16.67	33.33	50.00	66.67	83.33	100.00	116.67	133.33	150.00	37.50	56.25	75.00	112.50	150.00	225.00	4.5
4.6	17.04	34.07	51.11	68.15	85.19	102.22	119.26	136.30	153.33	39.19	58.78	78.37	117.56	156.74	235.11	4.6
4.7	17.41	34.81	52.22	69.63	87.04	104.44	121.85	139.26	156.67	40.91	61.36	81.82	122.72	163.63	245.44	4.7
4.8	17.78	35.56	53.33	71.11	88.89	106.67	124.44	142.22	160.00	42.67	64.00	85.33	128.00	176.67	256.00	4.8
4.9	18.15	36.30	54.44	72.59	90.74	108.89	127.04	145.19	163.33	44.46	66.69	88.93	133.39	177.85	266.78	4.9
5.0	18.52	37.04	55.56	74.07	92.59	111.11	129.63	148.15	166.67	46.30	69.44	92.59	138.89	185.19	277.78	5.0
5.1	18.89	37.78	56.67	75.56	94.44	113.33	132.22	151.11	170.00	48.17	72.25	96.33	144.50	192.67	289.00	5.1
5.2	19.26	38.52	57.78	77.04	96.30	115.56	134.81	154.07	173.33	50.07	75.11	100.15	150.22	200.30	300.44	5.2
5.3	19.63	39.26	58.89	78.52	98.15	117.78	137.41	157.04	176.67	52.02	78.03	104.04	156.05	208.07	312.11	5.3
5.4	20.00	40.00	60.00	80.00	100.00	120.00	140.00	160.00	180.00	54.00	81.00	108.00	162.00	216.00	324.00	5.4
5.5	20.37	40.74	61.11	81.48	101.85	122.22	142.59	162.96	183.33	56.02	84.03	112.04	168.05	224.07	336.11	5.5
5.6	20.74	41.48	62.22	82.96	103.70	124.44	145.19	165.93	186.67	58.07	87.11	116.15	174.22	332.30	348.44	5.6
5.7	21.11	42.22	63.33	84.44	105.56	126.67	147.78	168.89	190.00	60.17	90.25	120.33	180.50	240.67	361.00	5.7
5.8	21.48	42.96	64.44	85.93	107.41	128.89	150.37	171.85	193.33	62.30	93.44	124.59	186.89	249.19	373.78	5.8
5.9	21.85	43.70	65.56	87.41	109.26	131.11	152.96	174.81	196.67	64.46	96.69	128.93	193.39	257.85	386.78	5.9
6.0	22.22	44.44	66.67	88.89	111.11	133.33	155.56	177.78	200.00	66.67	100.00	133.33	200.00	266.67	400.00	6.0
6.1	22.59	45.19	67.78	90.37	112.96	135.56	158.15	180.74	203.33	68.91	103.36	137.82	206.72	275.63	413.44	6.1
6.2	22.96	45.93	68.89	91.85	114.81	137.78	160.74	183.70	206.67	71.19	106.78	142.37	213.56	284.74	427.11	6.2
6.3	23.33	46.67	70.00	93.33	116.67	140.00	163.33	186.67	210.00	73.50	110.25	147.00	220.50	294.00	441.00	6.3
6.4	23.70	47.41	71.11	94.81	118.52	142.22	165.93	189.63	213.33	75.85	113.78	151.70	227.56	303.41	455.11	6.4
6.5	24.07	48.15	72.22	96.30	120.37	144.44	168.52	192.59	216.67	78.24	117.36	156.48	234.72	312.96	469.44	6.5
6.6	24.44	48.89	73.33	97.78	122.22	146.67	171.11	195.56	220.00	80.67	121.00	161.33	242.00	322.67	484.00	6.6
6.7	24.81	49.63	74.44	99.26	124.07	148.89	173.70	198.52	223.33	83.13	124.69	166.26	249.39	332.52	498.78	6.7
6.8	25.19	50.37	75.56	100.74	125.93	151.11	156.30	201.48	226.67	85.63	128.44	171.26	256.89	342.52	513.78	6.8
6.9	25.56	51.11	76.67	102.22	127.78	153.33	178.89	204.44	230.00	88.17	132.25	176.33	264.50	352.67	529.00	6.9
7.0	25.93	51.85	77.78	103.70	129.63	155.56	181.48	207.41	233.33	90.74	136.11	181.48	272.22	362.96	544.44	7.0
7.1	26.30	52.59	78.89	105.19	131.48	157.78	184.07	210.37	236.67	93.35	140.03	186.70	280.05	373.41	560.11	7.1
7.2	26.67	53.33	80.00	106.67	133.33	160.00	186.67	213.33	240.00	96.00	144.00	192.00	288.00	384.00	576.00	7.2
7.3	27.04	54.07	81.11	108.15	135.19	162.22	189.26	216.30	243.33	98.69	148.03	197.38	296.05	394.74	592.11	7.3
7.4	27.41	54.81	82.22	109.63	137.04	164.44	191.85	219.26	246.67	101.41	152.11	202.81	304.22	405.63	608.44	7.4
7.5	27.78	55.56	83.33	111.11	138.89	166.67	194.44	222.22	250.00	104.17	156.25	208.33	302.50	416.67	625.00	7.5
7.6	28.15	56.30	84.44	112.59	140.74	168.89	197.04	225.19	253.33	106.96	160.44	213.93	320.89	427.85	641.78	7.6
7.7	28.52	57.04	85.56	114.07	142.59	171.11	199.63	228.15	256.67	109.79	164.69	219.59	329.39	439.19	658.78	7.7
7.8	28.89	57.78	86.67	115.56	144.44	173.33	102.22	231.11	260.00	113.67	169.00	225.33	338.00	450.67	676.00	7.8
7.9	29.26	58.52	87.78	117.04	146.30	175.56	204.81	234.07	263.33	115.58	173.36	231.15	346.72	462.30	693.44	7.9
8.0	29.63	59.26	88.89	118.52	148.15	177.78	207.41	237.04	266.67	118.52	177.78	237.04	355.56	474.07	711.11	8.0
8.1	30.00	60.00	90.00	120.00	150.00	180.00	210.00	240.00	270.00	121.50	182.25	243.00	364.50	486.00	729.00	8.1
8.2	30.37	60.74	91.11	121.48	151.85	182.22	212.59	242.96	273.33	124.52	186.78	249.04	373.56	498.07	747.11	8.2
8.3	30.74	61.48	92.22	122.96	153.70	184.44	215.19	245.93	276.67	127.58	291.36	255.15	382.72	510.30	765.44	8.3
8.4	31.14	62.22	93.33	124.44	155.56	186.67	217.78	248.89	280.00	130.67	196.00	261.33	392.00	522.67	784.00	8.4
8.5	31.48	62.96	94.44	125.93	157.41	188.89	220.37	251.85	283.33	133.79	200.69	267.59	401.39	535.19	802.78	8.5
8.6	31.85	63.70	95.56	127.41	159.26	191.11	222.96	254.81	286.67	136.96	205.44	273.93	410.89	547.85	821.78	8.6
8.7	32.22	64.44	96.67	128.89	161.11	193.33	225.56	257.78	290.00	140.17	210.25	280.33	420.50	560.67	841.00	8.7
8.8	32.59	65.19	97.78	130.37	162.96	195.56	228.15	260.74	293.33	143.41	215.11	286.81	430.22	573.63	860.44	8.8
8.9	32.96	65.93	98.89	131.85	164.81	197.78	230.74	263.70	296.67	146.69	220.03	293.37	440.05	586.74	880.11	8.9
9.0	33.33	66.67	100.00	133.33	166.67	200.00	233.33	266.67	300.00	150.00	225.00	300.00	450.00	600.00	900.00	9.0
9.1	33.70	67.41	101.11	134.81	168.52	202.22	235.93	269.63	303.33	153.35	230.03	306.70	460.05	613.41	920.11	9.1
9.2	34.07	68.15	102.22	136.30	170.37	204.44	238.52	272.59	306.67	156.74	235.11	313.48	470.22	626.96	940.44	9.2
9.3	34.44	68.89	103.33	137.78	172.22	206.67	241.11	275.56	310.00	160.17	240.25	320.33	480.50	640.67	961.00	9.3
9.4	34.81	69.63	104.44	139.26	174.07	208.89	243.70	278.52	313.33	163.63	245.44	327.26	490.89	654.52	981.78	9.4
9.5	35.19	70.37	105.56	140.74	175.93	211.11	246.30	281.48	316.67	167.13	250.69	334.26	501.39	668.52	1002.78	9.5
9.6	35.56	71.11	106.67	142.22	177.78	213.33	248.89	284.44	320.00	170.67	256.00	341.33	512.00	682.67	1024.00	9.6
9.7	35.93	71.85	107.78	143.70	179.63	215.56	251.48	287.41	323.33	174.24	261.36	348.48	522.72	696.96	1045.44	9.7
9.8	36.30	72.59	108.89	145.19	181.48	217.78	254.07	290.37	326.67	177.85	266.78	355.70	533.56	711.41	1067.11	9.8
9.9	36.67	73.33	110.00	146.67	183.33	220.00	256.67	293.33	330.00	181.50	272.25	363.00	544.50	726.00	1089.00	9.9
10.0	37.04	74.07	111.11	148.15	185.19	222.22	259.26	296.30	333.33	185.19	277.78	370.37	555.56	740.74	1111.11	10.0
10.1	37.41	74.81	112.22	149.63	187.04	224.44	261.85	299.26	336.67	188.91	283.36	377.82	566.72	755.63	1133.44	10.1
10.2	37.78	75.56	113.33	151.11	188.89	226.67	264.44	302.22	340.00	192.67	289.00	385.33	578.00	770.67	1156.00	10.2
10.3	38.15	76.30	114.44	152.59	190.74	228.89	267.04	305.19	343.33	196.46	294.69	392.93	589.39	785.85	1178.78	10.3
10.4	38.52	77.04	115.56	154.07	192.59	231.11	269.63	308.15	346.67	200.30	300.44	400.59	600.89	801.19	1201.78	10.4
10.5	38.89	77.78	116.67	155.56	194.44	233.33	272.22	311.11	350.00	204.17	306.25	408.33	612.50	816.67	1225.00	10.5
10.6	39.26	78.52	117.78	157.04	196.30	235.56	274.81	314.07	353.33	208.07	312.11	416.15	624.22	832.30	1248.44	10.6
10.7	39.63	79.26	118.89	158.52	198.15	237.78	277.41	317.04	356.67	212.02	318.03	424.04	636.05	848.07	1272.11	10.7
10.8	40.00	80.00	120.00	160.00	200.00	240.00	280.00	320.00	360.00	216.00	324.0.	432.00	648.00	864.00	1296.00	10.8
10.9	40.37	80.74	121.11	161.48	201.85	242.22	282.59	322.96	363.33	220.02	330.03	440.04	660.05	880.07	1320.11	10.9
11.0	40.74	81.48	122.22	162.96	203.70	244.44	285.19	325.93	366.67	224.07	336.11	448.15	672.22	896.30	1344.44	11.0
11.1	41.11	82.22	123.33	164.44	205.56	246.67	287.78	328.89	370.00	228.17	342.25	456.33	684.50	912.67	1369.00	11.1
11.2	41.48	82.96	124.44	165.93	207.41	248.89	290.37	331.85	373.33	232.30	348.44	464.59	696.89	929.19	1393.78	11.2
11.3	41.85	83.70	125.56	167.41	209.26	251.11	292.96	334.81	376.67	236.46	354.69	472.93	709.39	945.85	1418.78	11.3
11.4	42.22	84.44	126.67	168.89	211.11	253.33	295.56	337.78	380.00	240.67	361.00	481.33	722.00	962.67	1444.00	11.4
11.5	42.59	85.19	127.78	170.37	212.96	255.56	298.15	340.74	383.33	244.91	367.36	489.82	734.72	979.63	1469.44	11.5
11.6	42.96	85.93	128.89	171.85	214.81	257.78	300.74	343.70	386.67	249.19	373.78	498.37	747.56	996.74	1495.11	11.6
11.7	43.33	86.67	130.00	173.33	216.67	260.00	303.33	346.67	390.00	253.50	380.25	507.00	760.50	1014.00	1521.00	11.7
11.8	43.70	87.41	131.11	174.81	218.52	262.22	305.93	349.63	393.33	257.85	386.78	515.70	773.56	1031.41	1547.11	11.8
11.9	44.07	88.15	132.22	176.30	220.37	264.44	308.52	352.59	396.67	262.24	393.36	524.48	786.72	1048.96	1573.44	11.9
12.0	44.44	88.89	133.33	177.78	222.22	266.67	311.11	355.56	400.00	266.67	400.00	533.33	800.00	1066.67	1600.00	12.0

Annual Meeting of the American Foundrymen's Association and the American Institute of Metals

The 18th annual convention of the American Foundrymen's Association was held at the La Salle Hotel, Chicago, Oct. 13 to 16, and in connection with it there were joint and separate meetings of the American Institute of Metals. The registered attendance aggregated over 600. An extensive exhibit of foundry and metal-working machinery and appliances was arranged in the pavilion of the stock-yards, and this attracted a large attendance.

Many of the papers dealt with matters of practical foundry work and with modern ideas of business management in manufacturing enterprises, but there were a number of papers relating to engineering and metallurgical subjects.

American Foundrymen's Association

Cast Steel—Steel casting was dealt with from different points of view, and a paper by Mr. Hiorth (Christiania, Norway) described "The Electric Induction Furnace and its use in the Manufacture of Steel," the description relating entirely to the Hiorth furnace. A paper on "Electric Steel Castings," by F. T. Snyder (Chicago), showed that there is an increasing use of electric furnaces for melting steel for small castings. The steel costs less to manufacture and is of better quality than that made in fuel-furnaces, the improved quality being primarily in the higher resistance to loads suddenly applied. It is specially advantageous, therefore, for parts subject to shock.

Castings of "electric" steel stand two and three times the number of drop-test blows required to break fuel-melted steel, while the tensile strength of the former is 5000 to 10,000 lb. higher than the latter, both having the same carbon content. The "electric" steel can readily be made very hot, so that thin sections can be poured with satisfactory results. The steel is quieter in the ladle, and is less liable to blow-holes, but has greater shrinkage than crucible or converter steel. As a rule, foundries using this process melt cold scrap in the furnace instead of refining melted iron from a cupola, the former method being the cheaper. The electric process is specially adapted for making alloy steels. A paper on electric furnaces for brass foundries was presented.

A paper by J. H. Ploehn (Davenport, Iowa), dealt with "Openhearth Furnace Design and Manipulation as Adopted for Foundry Work," and one by W. M. Carr (Erie, Penn.), gave some observations on "Miniature or Detachable Openhearth Furnaces." This latter paper gave the results of three years' experience with such furnaces of 1 to 2½-tons capacity per heat. The furnace is cylindrical, and can be detached from the flue connections, being then handled by a crane and moved from mold to mold while the contents are tapped directly into the molds (no ladle being used). A paper by R. A. Bull (Granite City, Ill.), discussed "Difficulties in Pouring Steel Castings," and one by E. R. Swanson (Granite City, Ill.), discussed "The Pattern Shop, with Relation to the Steel Foundry."

Cast Iron—In a paper on "Cast Iron Specifications and Inspection," R. S. McPherran (Milwaukee) advocated greater uniformity as to size of test bars and specified breaking-loads. He questioned the general use of the term semi-steel for cast iron having varying percentages of steel scrap added in the cupola. A study of "Gray Iron for Motor Car Castings" was read by H. B. Swan (Detroit), who showed a number of interesting micro-photographs of different grades of iron, and Robert Crawford (Detroit) had a short paper on "Automobile Cylinder Founding." The manufacture of "Close-Grained Soft Cast-Iron" was discussed in a paper by John J. Porter (Staunton, Va.); he pointed out that for machine work there is a demand for iron which is both soft and close-grained, and while it is true that close-grain goes generally with a very hard iron, it is possible to obtain the desired combination.

Malleable Iron—This material received considerable attention, and in a paper on "Malleable Troubles," Dr. Moldenke (Watchung, N. J.), reviewed some of the special difficulties in this branch of the industry. A lengthy paper by E. L. Leasman (Boscobel, Wis.), presented a study of "The Annealing Process for Malleable Castings," accompanied by several micro-photographs, and one by P. Rodigin (Russia) gave the results of a number of tests in adding various alloy elements to the iron.

Foundry and Furnace Work—There is still much opportunity for improvement in cupola work, and Dr. Moldenke had a paper on "Rational Cupola Melting Practice," as well as one on "The Centrifugal Blower for Foundry Use." This type of blower is more efficient but more expensive, and is best adapted for foundries using the continuous melting process. It has been applied to a very limited extent as yet. A paper by A. W. Belden (U. S. Bureau of Mines) on "Foundry-Cupola Gases and Temperatures" was a reprint of a bulletin covering investigations on this line. In a paper on "Compressed Air as a Foundry Necessity," by A. P. Murray (East Cambridge, Mass.), a review was given of the various applications of compressed-air for hoists, elevation, molding machines, sand screens, rammers, hand tools, spraying devices and blast apparatus, etc. Different forms of compressors were described also.

Pulverized Coal for Furnaces—An interesting paper by W. S. Quigley (New York) dealt with "The Use of Powdered Coal as Fuel." This stated that plants have been installed capable of handling 240 tons per day, and larger plants now being installed can mill, distribute and burn 740 tons per day. These are for metallurgical furnaces for puddling, reheating, pipe welding, annealing, openhearth, etc. The coal must be very dry, with not over 0.5% moisture, and of such fineness that 93 to 95% will pass a 100-mesh sieve and 80 to 85% will pass a 200-mesh sieve. A forge-shop furnace formerly requiring 650 lb. of bituminous coal per hour now consumes only 350 lb. of pulverized coal and heats the work 20% quicker. The cost of installation of a pulverized-coal plant was said to be less than that of a producer-gas plant.

American Institute of Metals

At the opening meeting of this association, the work of the U. S. Bureau of Standards in regard to ferrous and nonferrous metals was outlined by Dr. G. K. Burgess, an abstract of whose paper appears elsewhere in this issue. A brief paper by L. C. Parsons reviewed the work

of the bureau in regard to nonferrous alloys. Dr. Burgess discussed the nomenclature of such alloys, and deprecated the use of personal or coined names or such meaningless terms as "manganese-bronze."

A paper on "The Boiling of Metals," by Joseph W. Richards, discussed the boiling or vaporization of metals, and the condensation of metallic vapors to metal. Other papers dealt with brass foundries. One of these (by E. F. Bulmahn) related to the advantages of producer-gas furnaces for such foundries, while another (by G. H. Clamer and Carl Hering) described the Hering electric furnace for melting brass. In addition, there were papers on scientific management of foundries and other plants.

Flood Protection for Lima, O.; Engineers' Recommendations

A report on protective work at Lima, Ohio, to protect the city against inundation by the Ottawa River, has been made by the W. J. Sherman Co., Consulting Engineers, of Toledo, Ohio. The report recommends extensive channel enlargement and correction work. We abstract some of its essential contents in the following:

Flood of March, 1913—From the rainfall record, the engineers adopt the figure of 8.75 in. as the total rainfall for five days, Mar. 23 to 27, 1913, and of this they take 3.40 in. as having fallen in the 24 hr. of Mar. 25. These figures are the actual averages for six observation points of the Weather Bureau, from Lima to Pellefontaine.

The Ottawa River has a drainage area above the Pennsylvania R.R. bridge at Lima of 140 sq.mi. From comparisons with flood figures for other drainage areas, according to older observations, a figure of 90 cu.ft. per sec. per sq.mi. is assumed for this territory, giving a total discharge of 12,600 cu.ft. per sec. at Lima. On the basis of three different runoff formulas, a flood discharge of 12,000 cu.ft. per sec. is obtained, corresponding to 85.6 cu.ft. per sec. per sq.mi. Again, assuming that the total rainfall of 3.4 in. on Mar. 25, ran off, evenly distributed over the whole day, a discharge of 12,800 cu.ft. per sec. is obtained. It is concluded that the actual maximum discharge of the Ottawa at Lima during the March flood was 12,000 cu.ft. per sec.

Further, the engineers design their work for this capacity, thus tacitly assuming that *no greater discharge need be anticipated.*

Velocity of Flow—The engineers compute a flow velocity, during the 1913 flood, of 7.89 ft. per sec., based on Kutter's formula, with a surface slope of 0.00107. They proposed to limit the velocity to 6 ft. per sec.—presumably to avoid scour—and they state that they designed their proposed improvements accordingly.

With the 12,000-ft. discharge and a 6-ft. flow velocity, a waterway of 2000 sq.ft. is required. This the engineers proceed to provide in an enlarged channel; at the same time, however, they propose to improve the river not only in width and depth, but also in slope, by designing various cutoffs and by removing reefs or bars, with the effect of equalizing and increasing the slope.*

Channel Widening—With a view to limiting the amount of property taken, the engineers decide in favor of a channel 125 ft. wide on bottom and 16 ft. in depth. The sides of the channel are to be formed by levees with 2:1 or 3:1 waterside slope, except that in the central area of the city, to avoid encroaching on the valuable adjoining property, concrete retaining-walls are to be constructed. A bridge clearance of 2 to 3 ft. is provided for. The bottom of the regulated channel is to be shaped concave, with center 4 ft. lower than the sides, to handle the dry-weather flow. The river in future is not to carry domestic and manufacturing sewage, however, as this is to be handled by a collector and disposal system, leaving only the storm water to go into the river.

The course of the river is in rock for a good part of its length. The downstream half of the work, being in earth, it is expected to excavate by dredging.

Bridge Reconstruction—Most of the bridges crossing the river in and near the city must be reconstructed, as they give an average waterway of only 1000 sq.ft. and the improvement is to be for double that area. Detail recommendations for the several bridges are made in the report.

Levees—The river channel, as improved, will be leveed along nearly the whole length of 8-9 mi. under consideration. The levee is designed with a top width of 16 ft. (allowing several feet for wear and wash) and side slopes of either 2:1 or (as recommended by the U. S. Engineers) 3:1. The total width of land occupied by the improved channel over outside slopes of levees will be 225 to 300 ft., as compared with about 100 ft. for the width occupied by the river at present. The difference will have to be acquired, except where it is ceded by the owners, which is likely to be the case at a good number of points.

In certain parts of the city a boulevard, and at one point a railway siding, is to occupy the top of the levee.

Retaining Wall—A total length of 10,100 ft. of reinforced-concrete retaining-wall is to be constructed, 5100 ft. on the left bank and 5000 ft. on the right bank.

River Straightening—In the 8-mile length of river considered, a number of cutoffs of curves are planned. They give a total saving of 12,000 ft. or 2.3 miles of distance, as compared with the present course of the river.

In connection with this work, the river is to be dredged and excavated for uniform slope of bottom, the present slope being very uneven, with ridges and pocekts.

Low-Water Regimen—To pond the water in low-water periods, two movable dams are projected, one at Collett St. bridge and the other at Main St. bridge. They are to be 6 ft. high, sufficient to flood the river for the entire distance from Collett St. to North St., about 2 miles. Vertical-lift dams are proposed.

Costs—For the entire section of river studied, a length of 9.5 mi. by the present channel (7.2 mi. by the proposed corrected channel), the cost is $1,172,000, with 3:1 waterside slopes to the levees. Various subdivisions of the work can of course be constructed successively, and this is recommended.

*The fact that with cleared and straightened river channel, and with deeper slope, a higher velocity of flow ought to result, is not mentioned in the report. Apparently the engineers consider that extreme floods in the improved channel will not flow faster than 6 ft. per sec., though the March flood had a velocity of 7.89.

The largest Conveyor Belts in the world, it is claimed, are being built by the Perdriau Rubber Co., Ltd., of Sydney, N. S. W., for a coal-loading plant at Fort Kembla. The belts are being made after specifications of the Public Works Department; each is approximately 1650 ft. long and will weigh 12 tons, being made up of seven-ply rubber and cotton in one continuous length, without joints, 36 in. wide. When rolled each belt will be too large to pass through the railway tunnels on the way to the port. The conveyor will carry coal about 1600 ft. at a rate of 1000 tons an hour.

EDITORIALS

The Prospects of State Highway Administration in New York

With the news of the impeachment and removal from office of Governor Sulzer, of New York, one of the first questions which occurred to many engineers was whether the change in administration in the State would mean another volcanic upheaval in the New York State highway organization.

As many of our readers will recall, the New York State highway work, after being handled in a more or less chaotic manner during the earlier years of activity, was put in the hands of a non-partisan State Commission by a law passed in the administration of Governor Hughes. In the succeeding administration of Governor Dix this law was repealed, and an entirely new set of men were placed in charge of the highway work with results which engineers familiar with the conditions generally agree are most deplorable from the standpoint of the taxpayers and the users of the roads.

Governor Sulzer's administration is at least to be given the credit of placing the State highway work in charge of John N. Carlisle, an officer who appears to have made an honest effort to establish the work on an efficient and economical basis. Elsewhere in this issue is reported the districting of the State and the assignment to the various districts of engineers selected under civil service rules. The time available since the first of the year, however, has been sufficient for Mr. Carlisle and his associates to do little more than reorganize their department and put it in shape for work. Whatever criticisms may be made concerning the present organization, it will certainly be agreed that it is far better for the taxpayers of New York that this organization should go ahead with the work of state highway construction and repair rather than that another revolutionary change should be inaugurated and a new set of officials be installed to learn the whole business over again. The unfortunate results of the last preceding change are still well remembered.

It is, therefore, of much interest to the engineering profession and to all interested in highway work to know that in all probability the organization created under Mr. Carlisle will be permitted to proceed with the work it has undertaken. It is to be noted that Commissioner Carlisle holds office by virtue of a law passed by the present New York Legislature which makes him secure in the tenure of his position for a term of years, subject only to removal under charges. More than this, however, there is reason to believe that in the efficient and honest conduct of his department Commissioner Carlisle will have the support of the new Governor of the State, Hon. Martin H. Glynn, who succeeded to the office on the retirement of Gov. Sulzer. Those who know the vicissitudes to which New York's famous $50,000,000 of good-road construction has been subject in the past, will appreciate the importance of this news.

The Life of Supports for Large Wood-Stave Pipe

The use of wood-stave pipes for penstocks and other conduits, we believe, has been fully as satisfactory as was expected when we noted its marked increase over 20 years ago. It was logical then to expect that the staves would be nearly as immune from the attack of rot as submerged wood, and today even the most conservative engineers concede a minimum life for a stave pipe which is continually filled with water under pressure, at about a quarter century. However, the very seepage of water which tends to promote long life of the pipe, is unfavorable to the life of most rigid supports, in those cases where the pipe cannot rest on an earth bed. Good examples of the need of such supporting structures are seen in the case of the 13½-ft. wood-stave pipe of the White Salmon River work, described in our issue of Oct. 9, and the semicircular wood-stave flume at the Puntledge River development, described in this issue. There is some experience to warrant the expectation that, under conditions similar to those of the two projects named, the supports will last about ten years, the maintenance costs running up rather rapidly in the last three or four years of this period. We know of some engineers who have employed wood supports for conduits to reduce the investment costs in the early years of struggling developments, expecting to replace them with more permanent substructures (like concrete) when renewal becomes imperative, and when presumably the projects will have secured a sound commercial footing. In all such cases, the original designers need to keep in mind the possibility of piecemeal replacement.

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A Difficult Point in the Railway Valuation Law

In commenting on the Federal Railway Valuation law at the time of its enactment last March, we strongly criticized those features of the law which require the unearthing of past records to ascertain the original cost of construction and all the past financial transactions with reference to the property. We have recently received from W. W. Gruber, a railway engineer of Cincinnati, a letter in which he sets forth his experience in actually carrying out an investigation of this sort for a short line of railway. We print his letter as follows:

> An article in a recent issue of your journal, stating that in the valuation of railroads by the Interstate Commerce Commission the original cost is to be ascertained, brought to mind a piece of work of this nature that the writer undertook to do less than a year ago, while employed in the office of the Engineer of Maintenance of Way of a Terminal Railroad company in the middle West.
>
> This company had 15 miles of main line and about 50 miles of side track, and about 180 acres of real estate including shops and other facilities, the original cost of which the general manager desired to have prepared in detail that he might be in position to furnish any information the Commission might ask for, and also to serve as a check on

any valuation they might make. Instructions to this effect were given to the writer with orders to call upon the accountants of the various offices for any information needed.

First to be considered was real estate. This was covered by about 250 deeds, several of which were for pieces of property that had been bought, sold and later again purchased. There were also receivership deeds and deeds to, and by, trustees all tending to make the work more tedious and uncertain. These conditions were all carefully gone over with a very competent accountant who had been in the service of the company a number of years in the Treasurer's office and other positions, and who was perfectly familiar with the various files from the latest, back to the dust-covered bundles in the attic and storeroom, where the out-of-date records had been kept and the remains of the files from the time of the construction of the road were stored.

From about 1901 to date, the desired information was very easily obtained from records in the Treasurer's office and from reports previously prepared covering this period. The next step was to look through the old files above mentioned, from which fully 50% of the number of deeds had to be accounted for, as no record was ever kept of the transactions of earlier days other than the old letters, vouchers, receipts, etc., which were mixed with various other papers and tied in bundles marked with the period they covered. After five or six days work in a dusty germ-laden atmosphere, less than 20 vouchers and letters had been found. These, however, did not represent the cost of the property represented by that many deeds. It was found that some of them were made only in part payment and in most cases there was no way of determining when all the parts had been found. Most of the vouchers were missing or other methods of payments had been used. Correspondence was found showing that payment had been made, in one or two cases at least by shares of stock. Other deeds were made in favor of trustees or officials who in turn paid the grantor, later making a deed in favor of the company "for $1 and other consideration."

After practically a week's work we had accounted for not more than 15% of the 125 parcels of property of which we had to find the original cost from these old files, and even these were unsatisfactory and unreliable. It was evident we could do no more and therefore we informed the Manager of the results of our search; and convinced him that finding the first cost from original records was not feasible.

Now that we encountered such obstacles in the matter of real estate, where we had before us just the definite thing of which we were trying to find the original cost, it is plainly to be seen how much more difficult it would be to find the original cost of track material, bridges, buildings, equipment, etc., and of the largest item of all, viz., labor, where there are no known quantities to account for, or to guide one in knowing when all these items have been accounted for, as we had when trying to get the real estate cost.

Should the most expert accountant examine every letter, report or record in these old files, he could draw few, if any, reliable conclusions as to original costs. In the first place there were many irregularities in keeping accounts and second there are so many papers missing that the final results could not even be considered approximate.

That this company used reasonably uptodate methods in their system of accounting, and now uses modern railroad methods as far as their needs demand, the writer is certain, as he has compared them with methods used by one of our large trunk lines where he was employed for several years previously.

This company is less than 30 years old and its properties are trifling in size compared to one of the trunk-line railways.

Considering that most trunk-line railways are two or three times as old, and that they are made up of numerous small roads that were built at various times and under different circumstances, when accounts were not as systematically kept as today, and further that these roads kept their records no more carefully and probably made no more effort to preserve them than this Terminal Railway Company did, while beyond a doubt many files were lost in the numerous changes of ownership and many facts were never recorded except in the minds of the construction engineers—taking all these facts into consideration the writer fails to see how the first cost of railroads can be obtained with even approximate accuracy.

It is a well established principle of law that no statute can compel the performance of an impossible task. The insertion of a few words by those who drafted the Federal Valuation law requiring the ascertainment of the original cost of railway property may perhaps compel the expenditure of hundreds of thousands or even millions of dollars' worth of time in useless searches; but it cannot possibly accomplish the end which was sought. Even if this information could be obtained, it would, in our opinion, have little or no pertinent value in connection with the question which the Federal Valuation Board has to determine, viz., the present value of the railways' physical property. There are two alternatives: either Congress should, at its next session, amend the Valuation Law, striking out all the clauses which require the attempted unearthing of past history, or else the Federal Valuation Board will have quietly to ignore this requirement of the law and defend its action on the ground that the requirement was impossible of fulfillment.

Water-Purification Progress at St. Louis

In 1866, the late James P. Kirkwood, a noted waterworks engineer in his day, spent some months in Europe on behalf of the City of St. Louis, Mo., with instructions (dated Dec. 11, 1865) to "inform himself in regard to the best process in use for clarifying river waters used for the supply of cities, whether by deposition alone, or by deposition and filtration combined * * * * * so that this Board may be able to appreciate how far the same mechanisms, and the same or similar combinations of materials, are likely to be adaptable to the purifying of the Mississippi water at St. Louis." In a report which was published in book form in 1869 with the title, "The Purification of River Waters," and which for many years was the only book on filtration in the English language, so far as we know, Mr. Kirkwood recommended that St. Louis adopt sedimentation and slow sand filtration. The city went no further than to build settling reservoirs at that time and for some thirty-five years did nothing else to improve the character of its water except to shift the intake from the Mississippi to the Missouri River and provide added means of sedimentation. Since 1904 the efficiency of the sedimentation basins, both as to turbidity and bacteria removal, has been increased by the use of sulphate of alumina as a coagulant.

The ever-increasing water consumption and the constant rise in potable water standards in this country has at last led St. Louis to enter upon the construction of water filters. These filters are described and the events leading up to them are outlined elsewhere in this issue by Edward E. Wall, water commissioner of St. Louis.

The vast difference between the filters which Mr. Kirkwood recommended St. Louis to build and those now under construction by that city afford striking testimony to the remarkable changes in water-supply engineering which have taken place in the past half century. In place of the vast area for the filters themselves and the small army of men which would have been required to clean them were St. Louis now dependent on filters of the type recommended by Mr. Kirkwood, the new filter plant will occupy a relatively small area and will be operated by a few men, aided by a number of efficient mechanical devices.

At the same time it is highly interesting to note that in broad general features of design and operation the same type of filters recommended by Mr. Kirkwood nearly fifty years ago are still in use throughout the civilized world, treating hundreds of millions of gallons of

water a day, all told, and giving most excellent results—but not, again broadly speaking, treating such water as the Missouri River at St. Louis; at least not doing it unaided, or aided by simple sedimentation alone.

Although Mr. Kirkwood recommended the best type of filters then available the operation of that type at St. Louis, as we now know full well, would have been attended with serious difficulties at frequent intervals of highly turbid water, even with more settling reservoir capacity than the city would have felt itself able to provide at that time.

It is the mechanical filter, with its ready means of washing and also its great ally, coagulation, which has made physically and financially practicable the clarification of such highly turbid waters as the Missouri, while at the same time practically eliminating color and bacteria, when such elimination is needed. In addition to all this, St. Louis now has chlorination at its command as an added safeguard against bacterial infection. We understand that this process will be used at St. Louis, and that liquid chlorine instead of hypochlorite will be employed.

To what extent the people or public officials of St. Louis realized that slow sand filters, even when aided by sedimentation, would be seriously overburdened in dealing with such waters as the Mississippi or the Missouri we cannot say.* For one reason or another, but probably more through inertia than anything else, the city did not live up to its light, or, in other words, did not follow the best engineering advice which it sought and secured.

Whatever excuses there may have been in the past for the failure of St. Louis to live up to its light, the city is now to be congratulated for having at last taken the final step which will place it in the rapidly growing sisterhood of cities which enjoy the comfort, convenience and safety of an ample supply of clear, colorless, germ-free water.

*In a foot note to his report, dated April, 1869, Mr. Kirkwood stated that the "public mind of St. Louis, so far as it has been expressed, does not yet seem to consider filtration important."

Should Fees Be Charged for the Use of Plans by Contractors Estimating on Work?

The Executive Committee of the General Contractors' Association of New York City, on Aug. 6, adopted the following resolutions:

Whereas, certain architectural and engineering firms and corporations have instituted a practice of charging a fee for the use of plans for estimating, and

Whereas, a practice has arisen of supplying an insufficient number of plans for the execution of a contract, and charging the contractor a fee for additional sets necessary for the completion of his contract, and

Whereas, certain private individuals have instituted the practice of requiring a certified check to be deposited with estimates,

Resolved, that the General Contractors' Association is opposed to the practice of paying for the use of plans for the purpose of estimating, and, except in the case of public work, its members should refuse to make any payment for the privilege of estimating, whether under the guise of a deposit, paying the cost of blueprinting, or otherwise, and

Resolved, that the General Contractors' Association is likewise opposed to the practice of making a charge for additional sets of drawings necessary for the carrying out of a contract, and its members should refuse to make any payment for additional drawings or specifications except when drawings are actually lost or destroyed, and

Resolved, that members of the General Contractors' Association except in the case of public work where required by law, should refuse to deposit certified checks or other securities with their estimates.

The point of view from which an engineer should view the questions raised by the above resolutions is the point of view of his client's interest. Is it or is it not for the interest of the client to charge a fee for the set of plans necessary for a contractor to use in order to prepare a close and careful estimate of the work on which he desires to bid? In public work, the letting of which is governed by statute, it is the general practice to furnish sets of plans free to any *bona fide* bidder. Where fees are charged, they are as a rule made nominal, merely to shut out those who desire to secure sets of plans for other purposes than bidding; or it is often the practice to make the fee merely a deposit, to be returned when a *bona fide* bid is filed.

The sound and valid reason for this practice on public work is that the work must be open to free competition, and that the charging of a fee for plans tends to discourage the submission of bids. The practice of requiring a certified check to accompany a bid is, of course, to prevent deposit of bids by irresponsible parties. This is not necessary, however, in the letting of private contracts where the principal or his engineer in letting a contract knows or can ascertain whether the bids submitted are *bona fide*, by responsible firms, and can discard bids from an irresponsible firm without any formality. To require every bidder to submit a certified check with his bid on a private contract, means the tying up of the banking funds of perhaps a dozen or a score of contracting firms for a period of perhaps a week or even a month while the bids are being considered and the award made. Further, misuse of such certified checks by the private parties receiving bids is always a possibility. We see, therefore, no good reason why such deposits should be required.

As for charging a fee for the use of plans required by *bona fide* bidders for estimating, it seems to us that there are few cases where the charging of such a fee will work in the long run to the interest of the party letting the contract. A good way to meet the situation where the detail plans involved in the work are exceedingly elaborate and expensive is to open the plans to inspection and study by contractors and their engineers in the office of the engineer in charge of the work. This can well be supplemented by preparing general specifications and general plans which can be cheaply reproduced in quantities by the phototype process and furnished free to any contractor who desires to look over the work in a preliminary way to decide whether he wishes to submit a bid.

We believe a little careful study of this matter by engineers will enable them to solve this problem to the advantage of both their clients and the contracting fraternity. It is no doubt true that a large expense is often incurred in making numerous sets of large blueprints for the supply of a large number of bidders on contract work. To charge a fee for these prints, however, simply distributes this burden to a number of contractors, only one of whom receives any return from the expenditure.

LETTERS TO THE EDITOR

The Need for Proper Inspection of Sewer Connections

Sir—From the installation of its first sewers in 1895-6 until last March this town allowed any person to lay house connections, subject to rules laid down by the department and subject also to a more or less perfunctory inspection for which a fee of $2 was charged, the inspector receiving the same. In many cases this was a ridiculously low figure to secure the services of a careful and competent inspector and since the town began, dating some time in April, 1913, to do the work itself, at cost to the abutter, there have been some corroborations of the need of a change.

One such came to light within a week. A connection which had been troublesome was uncovered, when it was found that some of the pipes were far enough apart at the joints to permit the insertion of one's finger. The plausible explanation is, it would seem, that backfilling was carried too far before the cement was sufficiently set. The soil is very wet in wet times, and was consequently heavy and slippery and tended to slide toward the house end of the trnch, carrying the pipe with it.

Very likely others of your readers have seen similar cases; it serves to emphasize more strongly the importance of rigid enforcement of specifications as to all details in this line of work.

NORMAN M. PAUL,
Clerk, Board of Sewer Commissioners.
Fairhaven, Mass., Oct. 16, 1913.

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The Purification of Panama Water-Supplies

Sir—I have read with much interest the article on "Panama Water-Supply and Purification Systems," in your issue of Oct. 2, 1913. Permit me to say that the article gives too much credit to the air treatment in comparing the plants at Agua Clara and Mt. Hope. The air treatment is absolutely necessary to the reduction of odors, beyond which its usefulness is doubtful except when treating the lower layers of reservoir water, which is an expensive experiment.

There are several things to be considered in comparing these two plants. First the type of filters: a gravity filter against a pressure filter through which the water is forced by a reciprocating pump at 70 lb. and with a loss running up to 8 or 10 lb. The pulsations of the pump are very noticeable in the filter building. The age of the reservoirs has no small effect and despite the proximity of the two watersheds there is considerable difference in the characteristics of the two waters. The mixing arrangements present a very important difference, that at Gatun being much more efficient. The mixing of chemicals with these waters must be instant and violent. The delay of a second or two between application and mixing prevents the proper precipitation from taking place. Small successive doses are without effect as to coagulation.

By treating separate volumes of water with different quantities of sulphate of alumina, we find that complete precipitation is produced by a dose 0.1 grain per gal. greater than a dose which produces absolutely no precipitate. This minimum effective dose reduces the color in Brazos water to approximately 10 p.p.m., the minimum dose.

My theory of the low-alkalinity consumption by aluminum sulphate is that the chemical, although an acid salt, is absorbed, to some extent, in the nature of a mordant by the vegetable coloring matter.

Of the condition of the iron I may say that Brazos water was dialized on June 11, 1909, when in its worst condition. The total iron (Fe) was 3.4 p.p.m., of which 2 p.p.m. passed the dializer and 1.4 p.p.m. were retained.

The preliminary treatment plant described as at Mt. Hope, is not at Mt. Hope but was a temporary plant built in an emergency on my recommendation at Cocoli, on the opposite side of the Isthmus.

The Mt. Hope preliminary plant consists of duplicate concrete storage tanks, float tank, and a 400,000-gal. basin having 20 sides and divided into eight compartments. The water takes a course similar to a figure 8, being thrown alternately to the center wall and the outside wall to increase the length of its course. The inlet and outlet are within two feet of each other.

The chemical feed is entirely by gravity both at Cocoli and Mt. Hope. The chemical is weighed and put into the old pressure solution tanks and a stream of water under pressure is passed through the tanks, discharging into the elevated storage tanks through 1½-in. copper pipe. The solution is readily effected and the flow of water continued up to a predetermined volume in the storage tanks.

This system might be useful in many plants as it does away with trouble some chemical pumps cause. It was first used, so far as I am aware, by the writer at the Mt. Hope plant here mentioned. It was described before the American Water Works Association in 1910 and later before the Canal Zone Medical Society in a paper on "Canal Zone Medical Supplies."

JOHN R. DOWNES,
Chemist in charge, Mt. Hope Filter, 1907-'09; Physiologist in charge, Zone Water-Supplies, 1909-'12.
Plainfield, N. J., Oct. 14, 1913.

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Neglected First Principles of Masonry Dam Design

Sir—George Holmes Moore, in his article in ENGINEERING NEWS of Sept. 4, 1913, p. 442, gives the most concise and lucid exposition of the First Principles of

Masonry Dam Design that the writer has yet seen published. He is certainly right in saying:

If it is doubted that the foregoing analyses, and the sections resulting from them, are an index of the coming standards of gravity-dam design, an inspection of all recent sections of high-gravity dams will reveal the slow change to more and more ample sections.

This "more ample section" cure for the things that make dams fail is the only one for dams that rely on their weight alone for their stability, and the one great difficulty, uplift, increases directly with the cure, making it quickly come to the point of being prohibitive in cost.

Mr. Moore strikes the key note of the trend of thought where he says:

Finally, he who reads may reckon that there is food for thought in the serious consideration given to types of dams which are as far removed as possible from dependence upon simple gravity. * * * * No failure of any [arch] dam has ever been recorded. No arched dam of any size or parentage has ever failed. Surely this should be sufficient and final.

The next move, then, should be to get at the design of a dam that automatically eliminates the difficulties that are inherent in the "gravity dam." Of what force and interest are "uniformly varying uplift," "full uniform uplift," "sliding," "overturning," etc., when in the perfected type of structural dam all these dangers and difficulties are automatically eliminated from the problem? Why trouble over long and intricate formulas for keeping the resultant within the middle third when it can be placed and kept at the exact middle of the base and all eccentricity of loading eliminated?

The answer lies in the use of a structural dam designed on scientific basic principles, the design to include the arch and the pyramid, wherein the water pressure itself is used to assist the weight of the structure to give it absolute stability, to the end that as nearly as may be all the stresses are resisted with an equal safety factor, and sliding, overturning and uplift are eliminated. Such a structure will contain the minimum of material because of the even distribution of the stresses, and hence will give higher safety factors in all parts at a less cost than for any other type of dam. There is no type of structure for the barrage of water that can be so readily adapted to meet any set or combination of conditions as the perfected multiple-arched dam, either as to length of crest, height of head or as to the character of the foundations. Where all other types have reached their limitations, either through cost or stresses, the multiple-arched type is still in the running, when the design is varied to suit the conditions.

The single-arched dam soon reaches the end of its usefulness for it is true that for a valley of great width, the long radius required will set up greater stresses than would be set up in a gravity dam of straight section, containing less material, but the point of safety is another thing. For equal stresses this may be true, because we load masonry to such a small fraction of its ultimate crushing strength, but the arched dam of long radius and high stress will stay put long after the straight section has failed, because it cannot fail till it crushes, and the safety factor against crushing is many times that for overturning or sliding in a straight section.

Only by the use of a wide base can there be safety in a gravity dam, and a wide base means a big bond issue.

JOHN S. EASTWOOD.

Hearst Bldg., San Francisco, Calif.,
Oct. 10, 1913.

The Diesel Oil Engine Ship "Wotan," which arrived in New York Oct. 4, completing her maiden voyage across the Atlantic, is the largest single-screw oil motor ship yet built. The "Wotan" is an oil-carrying tank vessel 123.14 meters long, 16 meters beam and 9 meters draft (412x52.5x29.5 ft.). She was built for the German-American Petroleum Co., of Hamburg, by the Reihersteig Ship & Machine Works, of Hamburg. The Diesel oil engines which propel her were consructed jointly by the builders and by Carels Freres, of Ghent, Belgium. An excursion to inspect the vessels at the Standard Oil Wharves, Bayonne, N. J., took place on Oct. 6, under the leadership of W. R. Haynie, American representative of Carels Bros. The growing confidence in the reliability of the Diesel engine for use at sea is shown by the fact that the ship is built as a single-screw vessel, while all previous large motor vessels have twinscrews.

The "Wotan's" engine has six cylinders of 600 mm. diameter and 1100 mm. stroke (19.7x36.1 in.) operating on the two-stroke cycle. At 90 r.p.m. the main engines can develop about 2500 hp. (metric) giving the ship when fully laden a speed of 9½ to 10 knots. On her maiden voyage an average speed of 8¼ knots was maintained, consuming about 7 tons of fuel oil per hour and the voyage was made in 18 days. The engines were not stopped during the entire voyage. Her oil bunkers carry fuel enough for a voyage of 30,000 nautical miles. Levers from the main engine drive circulating pumps for the jacket water, bilge pumps and pumps for the scavenging air. A Reavell four-stage air compressor on the main shaft furnishes the high-pressure injection air. An auxiliary four-stroke cycle Diesel engine can drive either an air compressor or an electric generator as required. A donkey boiler, oil-fired, furnishes steam for operating the steering machine, anchor winches and various auxiliary machines when entering a port.

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Change in the Panama Canal Organization and the History of the Central Division—The Central division of the Panama Canal organization was abolished at the close of business, Friday, Oct. 10, the day the Gamboa dike was destroyed and the waters of Gatun Lake allowed free access to the canal prism through Culebra cut.

The Central division was first organized on July 1, 1909, succeeding the Department of Excavation and Dredging, and was assigned the canal territory extending from the south toe of Gatun dam to the north end of the lock site at Pedro Miguel, a distance along the axis of the canal of 31.69 miles.

The Canal Work was divided into five construction districts, and was placed in charge of Lieut-Col. D. D. Gaillard, as Division Engineer, with the following assistants: Louis K. Rourke, Assistant Division Engineer; A. S. Zinn, Resident Engineer; Mark W. Tenny, R. W. Hebard, W. L. Thompson and George H. Ruggles, Assistant Engineers. Of the Division Engineer's assistants at that time, only two, Messrs. Zinn and Tenny, are now connected with the organization.

With the resignation of Mr. Rourke on May 1, 1910, a reorganization of the work was effected. The position of Assistant Division Engineer was abolished, and that of General Superintendent of Construction created. The five construction districts were consolidated into four.

On May 10, 1911, the engineering branch of the division was reorganized. Previous to this time, the field and office work had been handled by the Resident Engineer at Empire, with offices in charge of Assistant Engineers at Las Cascadas and Paraiso. The two latter offices were abolished, and their work transferred to the office of the Resident Engineer at Empire.

The Chagres district of the division was abolished on Aug. 19, 1912, and the title of it changed to the Relocation Dumps.

The following changes in organization were made effective Oct. 11, 1913:

All surveying work was transferred to W. G. Comber, Resident Engineer, Sixth division, under whose supervision excavation in the wetted prism will be completed by dredging.

Transportation forces were transferred to the Second division of the Chief Engineer's office, under the supervision of the Superintendent of Transportation, who also now has supervision of transportation in the First division, the Fifth division, and the transportation forces of the Fortifications division on the Pacific side.

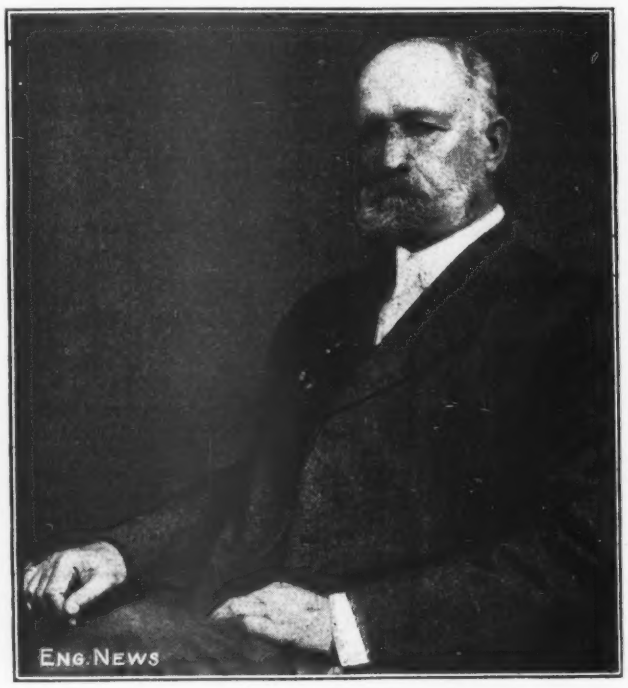
The steamshovel and other construction work of the Central division outside the wetted prism was transferred to Chief Engineer's office, A. S. Zinn, Resident Engineer, reporting to the Chief Engineer. The force under Mr. Zinn will be carried on the rolls of the Chief Engineer's Office.

Of the three great construction divisions organized on July 1, 1908—Atlantic, Central and Pacific—only one, the Atlantic, under Lieut.-Col. W. L. Sibert, remains in existence. The Pacific Division was abolished upon the resignation of S. B. Williamson, its Division Engineer, on Jan. 1, 1913. ["Canal Record."]

Brigadier-General Dan C. Kingman, Chief of Engineers, U. S. A.

The new Chief of the Corps of Engineers, U. S. A., Dan C. Kingman, who succeeded Brig.-Gen. William T. Rossell, Oct. 11, comes to the head of the Corps after 38 years of service and with 2½ years to serve before he will have reached the age limit of 64, at which Army Engineer officers are retired.

Dan C. Kingman was born Mar. 6, 1852, at Dover, N. H. His father was John W. Kingman, whose ancestors settled in Massachusetts Colony in 1635. John W. Kingman graduated from Harvard University in 1843 and studied law in the office of Daniel Webster. During the Civil War he served as Colonel of the 15th New Hampshire Volunteers, and was afterward Associate Justice of the United States Court of the Territory of Wyoming.



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The son, Dan C. Kingman, graduated from the United States Military Academy at West Point, the second in his class, in 1875. For three years following he was assigned to duty with the engineer troops at Willets Point, N. Y., as Second-Lieutenant. One of his first experiences in engineering work was an examination and report, under Gen. Q. M. Gilmore, of the condition of the Washington Monument, Washington, D. C., which had then been for several years in an unfinished state and was found to be out of plumb.

Lieut. Kingman was commissioned First Lieutenant in 1879 and for three years was instructor in civil and military engineering at the Military Academy. He was then sent to Omaha, Neb., as Engineer Officer of the Department of the Platte, where he remained for five years, making explorations and surveys for military roads in Nebraska, Wyoming, Utah and Idaho. In 1883, he was selected by Gen. Sheridan to take charge of the roads and bridges in the Yellowstone National Park, and while on this assignment prepared plans for the development of the park which have since been carried out with little variation.

In 1886, Lieut. Kingman was promoted to the rank of Captain and ordered to New Orleans for duty under the Mississippi River Commission. He was given charge of the district from Vicksburg to the head of the passes at the mouth of the river. In 1890, he had charge of the protective works against the greatest flood which had occurred up to that time; and for his services in this emergency he received the thanks, by a joint resolution of the Senate and House of Representatives, of the State of Louisiana.

From his Mississippi River work he was ordered to Oswego, N. Y., to take charge of the harbor work on the south shore of Lake Ontario, and the fortifications at Oswego and Niagara. In 1895, he was placed in charge of the improvement of the Tennessee River and its tributaries. While on this work he supervised the construction of the great masonry lock at Colbert Shoals. In 1897, he was promoted to the rank of Major.

In 1901, Maj. Kingman was transferred to Cleveland, Ohio, where he had charge of the harbor-improvement work on the south shore of Lake Erie. He was commissioned Lieutenant-Colonel in 1905 and in 1906 ordered to Savannah, Ga., where for the past seven years he has been Engineer of the Southeast Division, in charge of all the coast work from Norfolk, Va., to the mouth of the Suwanee River in Florida. In addition, he has served as a member of the Board of Engineers on fortifications for the Southeast Division and as a member of the National Land Defense Board. He was promoted to be Colonel in 1908.

Gen. Kingman has three sons in the United States Army; Capt. John J. Kingman, Corps of Engineers, U. S. A., at present on duty with the Central Division, at Louisville, Ky.; First-Lieut. Ralph W. Kingman, of the 16th Infantry and Second-Lieut. Frederick E. Kingman, Coast Artillery.

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The Committee on Hulls and Bulkheads, Department of Commerce, composed of Rear Admiral W. L. Capps, Chief Constructor and Naval Constructor David W. Taylor, U. S. N.; George Uhler, Supervising Inspector General, Steamboat-Inspection Service; and E. T. Chamberlain, Commissioner of Navigation, which was to prepare recommendations for the use of the American delegation to the International Conference on Safety at Sea, to be held in London, England, on Nov. 12, reported as follows:

A law should be enacted dictating the maximum and minimum freeboard for all classes of vessels. Standards of hull construction should be prescribed after careful investigation by experts, and the rules of classification societies should be treated on their merits and approved or disapproved accordingly. Complete investigation should be made as to what reserve of buoyancy should be provided for in the design of a vessel under certain specified conditions of damage. For transoceanic vessels which are essentially cargo carriers and in which extensive subdivision of the hull by transverse bulkheads would be impracticable, ample boat capacity at the davits on each side should be provided for all persons on board, so that in the event of collision or other accident damaging the boats on one side there would be ample lifeboat capacity on the opposite side for all persons on board. Investigation should also be made and regulations prescribed for certain classes of vessels governing the maximum number of adjacent main compartments which could be flooded without jeopardizing the safety of the vessel.

It is considered necessary to formulate and prescribe rules for spacing, strength and tests of water-tight bulkheads. Bulkhead doors should be controlled from the bridge, yet be capable of operation at the door itself; also, for doors in important water-tight bulkheads, independent mechanical operation from the bulkhead deck is desirable. All lights below the bulkhead deck should be fixed, except under unusual circumstances, due to type and size of vessel and location of the bulkhead deck. In the wake of machinery spaces and other large compartments of certain classes of large passenger vessels, double bottom or its equivalent should extend to the deck above load water line. It is also considered desirable that for such vessels the double bottom should extend not only under the engine room, but also under all main compartments forward and abaft engine and boiler spaces.

Among the American delegates to the conference are: E. T. Chamberlain, Commissioner of Navigation, Rear Admiral W. L. Capps, U. S. N.; Capt. G. F. Cooper, Hydrographer U. S. N., and H. L. Ferguson, General Shipbuilding & Drydock Co.

Report on the Drainage of the Florida Everglades

An important report on the drainage of the Everglades, in southern Florida, by a board of engineers, has just been made public, although the report itself was submitted on Nov. 12, 1912. The engineers composing the board were Prof. Daniel W. Mead, of Chicago, and the University of Wisconsin; Allen Hazen, of New York City, and Leonard Metcalf, of Boston, Mass. The board received its instructions from V. W. Helm, of Chicago, president of the Everglade Land Sales Co., in the form of a letter dated July 23, 1912. The letter stated that the State of Florida had "undertaken to furnish all necessary main canals for the drainage of the so called 'Upper Everglades'"; that the company was the owner of 70,000 acres of land in the Everglades; and that it wished to know "whether or not the present system of canals as outlined by the State of Florida is sufficient to take care of the runoff from the Upper Everglades as a whole—and particularly of the 70,000 acres owned by us." In case the state's drainage scheme was not sufficient for the purpose just stated the company wished to know both what amplification of the state scheme was necessary, and, in case that amplification was not provided, whether it would be possible for the company to dike its holdings on the north and west sides in such a manner as to protect them, and also what other work would be required on behalf of the company.

We give below the findings and recommendations of the board of engineers together with some other information taken from their report—which we should add has not been printed but has kindly been made available to us through the courtesy of Mr. Helm and Mr. Hazen.

Before taking up the report proper a few statements may well be made regarding the location and character of the Everglades and before doing that it may be said that in its letter of transmittal the board of consulting engineers stated that while it found the drainage of the Everglades feasible from engineering and financial viewpoints, yet the work done and projected by the State of Florida, is in its opinion "totally inadequate."

The Everglades have an area of about 4000 sq.mi. and occupies about half of that portion of southern Florida which is south of Lake Okeechobee. The Everglades are in effect a vast marsh covered with water which varies in area and depth according to the rainfall and associated conditions.

Closely related to the Everglades drainage problem is Lake Okeechobee, which has an area of approximately 700 sq.mi. and a drainage area of about 6000 sq.mi. Prior to 1884, when the canal was cut from the lake to the Caloosahatchee River, the lake had no reliable outlet. The canal now gives the lake direct connection with the Gulf of Mexico.

The high-water level of the lake is about 22 ft. above the sea. Quoting now from the report:

> During high water or the rainy season, the lake discharges into the Caloosahatchee River and overflows its southerly border or margin into the Everglades; but during extreme high water in the Caloosahatchee River, when the lake itself is not at flood stage, a reversal of flow sometimes occurs during local storms of extreme severity on the Caloosahatchee drainage area, and then the Caloosahatchee River is found to discharge not only to the sea, but also into Lake Okeechobee for a limited period of time.

The Caloosahatchee River "is shallow, varying in depth from 6 to 12 ft., more or less, and is sluggish and of meandering type. It is not an important factor in the drainage of Lake Okeechobee * * *."

Not only is the control of Lake Okeechobee an important factor in the drainage of the Everglades, but its possible storage capacity "will become of the greatest importance when the irrigation of these lands is undertaken in the future." The engineers state that once the overflow of the lake is controlled the drainage of the Everglades will become a simple problem and after that the lake will be of greater value as a reservoir for irrigation than as a reservoir for storm-flow equalization purposes.

The report reviews in considerable detail the available meager data relating to the rainfall, runoff and evaporation, directly and indirectly applicable to the Everglades problem. The report emphasizes the need for further data of this kind and for additional surveys and studies before the Everglades problem can be properly solved.

The findings and conclusions of the report of Messrs. Mead, Hazen and Metcalf may now be given:

> FINDINGS—In our judgment, the present system of canals as outlined by the State of Florida is not sufficient to take care of the runoff from the Upper Everglades as a whole.
>
> We find that "to ascertain what amplification of the present system will be required to furnish a satisfactory drainage" will require a large amount of study and investigation, together with extended observations and surveys.
>
> It is manifestly unfair that with your relatively small holdings you should be required to meet the large expense of a full and comprehensive study of the drainage of the entire Everglades, and the Board has, therefore, investigated these matters more particularly with reference to the immediate condition and needs of your property, leaving the more detailed study of the larger problem for future investigation by the State, or by an association of all those interested in the reclamation of the Everglades.
>
> We find that it will be possible to dike your present holdings in such a manner as to make them practically independent of the remainder of the Everglades, and we have determined what additional outlets and canals will be necessary in order to accommodate the runoff from the area involved.
>
> We have, as far as practicable, without undertaking complete investigations and surveys, included in this report specific information as to the canals, laterals, ditches, etc., which should be installed by your company in order to properly drain your specific acreage, assuming that the necessary main canals to tide water will be installed. Your Board of Engineers has also designated such additional main canals and laterals as will be necessary for the purpose, and, in a general way, the routes of such canals on maps submitted with this report.
>
> GENERAL CONCLUSIONS—Without attempting to analyze and pass upon all of the details of the plans for the reclamation of the Everglades as outlined by the Engineers of the Trustees of the Internal Improvement Fund of the State of Florida, or to offer suggestions as to the lines on which the reclamation of the Everglades should be accomplished, certain conclusions can be drawn from the information secured which may be considered as fairly definite.
>
> Your Board of Engineers has reached the following conclusion concerning the reclamation of the Everglades:
>
> 1. The drainage of the Florida Everglades is possible from an engineering standpoint. The various developments along the edge of the Everglades clearly indicate the great agricultural possibilities of the land, and we believe that the value of the land when drained and developed will much more than repay the cost of reclamation.
>
> 2. The work already done by the State, and at present definitely projected, is entirely inadequate for the drainage of the Everglades.
>
> 3. The canals now under construction and definitely projected will afford a more ready channel for the passage of flood water from the lake into the Everglades, and, while possibly benefiting to some extent the lands adjoining Lake Okeechobee, will undoubtedly aggravate the flood conditions along their lower reaches, both in amount and in duration, with the possible exception of certain lands favorably located in immediate proximity to the outlets of the canals. During

dry seasons, the canals will assist materially in the drainage of the lands immediately adjoining them, but the flooding which will follow heavy rains will make the improved conditions during dry weather of little practical value.

4. It is, in the judgment of your Board of Engineers, financially inexpedient to attempt to complete the reclamation of the entire Everglades in the immediate future. On account of the great cost involved, and the large amount of land which would thus be thrown at once upon the market, this vast area cannot be sold and brought under successful cultivation with sufficient rapidity to meet the interest on the capital required and the maintenance charges.

5. The cost involved in the complete drainage of the Everglades will be so great as to render it difficult, if not impossible, even were it expedient, for the State of Florida to furnish the necessary funds for immediate development, and consequently there is no hope for the completion of the work, as a whole, in the near future.

6. The magnitude of the possible future agricultural development of the Everglades will require a great and gradual readjustment of market conditions, railroad facilities, rate adjustments and agricultural experiment work, which will involve much time, capital and labor.

7. For the reasons here given, the reclamation of the Everglades must, in our judgment, be a progressive development. Much of the work can be completed only after the earlier lands are drained and brought under successful cultivation.

8. The complete reclamation of the Everglades will require:

a. The control of Lake Okeechobee: To prevent its overflow and the flooding of the Everglades from this source. To provide storage for ultimate irrigation of the drained land.
b. The construction of numerous drainage canals or channels: For drainage purposes, and ultimately, for the distribution of the stored waters of Lake Okeechobee for the irrigation of the drained land.

9. The drainage of Lake Okeechobee can be better accomplished by the construction of canals practically independent of the canals intended primarily for the drainage and irrigation of the Everglades.

10. The canals required for the drainage of Lake Okeechobee and the Everglades must have many times the capacity and will involve many times the cost of those at present under construction or projected by the State of Florida.

The canals should be much deeper than those under construction or projected by the State. The elevation above the sea of the land to be drained is not great, the available slopes in the canals in any event will be very slight, and the lowering of the ground surface by shrinkage of the soil when drained must be provided for. For effective drainage it is essential that the water level in the canals should be brought substantially to sea level at their mouths. This means that the canals must be deepened so that at their mouths the full discharging capacity will be reached in a prism that is below sea level. The State canals under construction and projected are particularly deficient in this respect, their bottoms being only a little below sea level, and their capacities being reached only with much higher water levels. Effective drainage of parts of the Everglades cannot be obtained by such shallow canals, however wide and numerous they may be.

11. It is apparent that the private lands now owned in the Everglades will not be effectually drained by the work now under way or projected by the State of Florida.

12. If the private lands are to be effectively drained within the immediate future, individual or collective effort will have to be exercised by the land owner. The work will be especially difficult on account of the fact that in most cases the State has sold alternate sections under which conditions any private drainage project will require the drainage of twice the land owned by private parties.

13. To accomplish effective reclamation work, a thorough and comprehensive study of this entire problem must be made. This study should involve a systematic study of rainfall conditions; the investigation of runoff and evaporation on the entire area considered; observations of the rise and fall of Lake Okeechobee, and the discharge of the various outlets from the Lake; study and experiments on the agricultural possibilities of the muck lands; the necessary relation of the water table to the cultivated surfaces; the requirements of irrigation, land shrinkage, etc.; more detailed surveys and examination of various canal routes, especially from Lake Okeechobee to the sea. These data, together with many others which will be found desirable as the study of this great project progresses, will be found essential as a basis for the design of an effective reclamation system, and for the preparation of a comprehensive and adequate plan for the complete control of Lake Okeechobee, and the reclamation of the Everglades.

14. To assist in the immediate reclamation of at least a part of the private and public lands in the Everglades, the coöperation of the State is essential:

a. In the preparation of plans which will admit of progressive reclamation by a union of State and private effort.
b. In the passage of a sound drainage act.
c. In the exchange of lands to permit of the segregation of the holdings of private owners.

15. For practical reclamation work, the available resources of the State can best be devoted largely to the control of Lake Okeechobee, the enlargement of the natural outlets, and the construction of additional outlets from the Everglades to the ocean, and to the progressive construction of adequate drainage channels from the outlets so provided into the interior of the Everglades.

Under the heading, "Runoff Conditions in the Everglades," mention is made of the lack of local data and light is sought from observations on river flows in other parts of the South. The intensity of the rainfall in the Everglades leads the Board of Engineers to conclude that the runoff there will be greater than the runoff in Louisiana. In some drainage districts in that state "which perhaps most nearly parallel the conditions found in the Everglades, the ditches and pumping plants built for drainage purposes are usually based upon a maximum runoff of from ¾ to 1 in. in the 24 hr.," or from 21 to 27 cu.ft. per sec. per sq.mi. of drainage area for areas of 10 sq.mi. or more.

The engineers arrived at the following conclusions as to canal capacities in the Everglades:

We conclude tentatively, therefore, that for complete drainage, when the areas are fairly concentrated, the ditch or canal capacities should provide for a discharge of about 1½ in. per 24 hr., or 40 cu.ft. per sec. per sq.mi. of drainage area on land tracts of 50 sq.mi. or less; not less than ¾ in. per 24 hr., or 21 cu.ft. per sec. per sq.mi. on tracts of about 200 sq.mi.; not less than ½ in. per 24 hr., or 14 cu.ft. per sec. per sq.mi. on tracts of about 750 sq.mi.; and that if the whole drainage discharge of the Everglades were concentrated in a single canal, it would not be safe to estimate upon a capacity at its outlet of less than ¼ in. in depth of runoff per 24 hr., or 7 cu.ft. per sec. per sq.mi. of drainage area.

For immediate construction purposes, it will probably be undesirable to design ditches for the smaller land areas for more than 1 in. capacity in 24 hr. This will probably afford ample drainage under most conditions, but may result in limited overflow during occasional heavy storms.

The provision of drainage facilities sufficient to remove the maximum floods would not be warranted.

An important conclusion of the Board is that the flood waters of Lake Okeechobee must be controlled by canals devoted chiefly to that purpose, since this control cannot be effected by "long canals designed for both the drainage of the lands of the Everglades and for the control of Lake Okeechobee." Moreover, the Everglades drainage canals should be so designed or supplemented with additional canals that the irrigation waters from the lake may be brought to the lands for that purpose.

As to the amount of flood water to be removed from Lake Okeechobee and the capacity of canals needed to control the lake, the latter being independent of the drainage district south of the lake, the report of the Board may be quoted as follows:

It is the opinion of your Board that the amount of water to be removed from Lake Okeechobee during floods will not be less than ¼ in. of runoff per 24 hr., and that it may be, in fact, considerably greater in exceptional rains; but during a considerable period of years, while the development of the Everglades is taking place, and during which the water of the lake is not used for irrigation, it will be possible to ordinarily hold the lake level at a low stage, and to use the storage in the lake temporarily for flood waters. Under these conditions half the flood flows, more or less, may be stored temporarily, and canals having a smaller capacity, or perhaps not more than ¼-in. runoff per 24 hr. may suffice.

Upon this basis the flood flow to be ultimately provided will be 40,000 cu.ft. per sec., requiring a channel from Lake

Okeechobee to the seaboard upon the shortest practicable route, approximately 1000 ft. wide and 15 ft. in depth below elev. 18 at the lake and 15 ft. below sea level at the point of discharge. For immediate requirements, with storage capacity in the lake utilized for storing flood flows, to be discharged as soon as possible, without holding them for use in irrigation, 20,000 cu.ft. per sec. must be provided for, requiring a canal 500 ft. wide, and of the depth previously mentioned.

In a very tentative way a canal system was outlined as follows:

If, for example, the Everglades were to be drained by a system of canals running east from the west side of the Everglades and provided with proper outlets to the seaboard, and if these canals were spaced three miles apart, allowing each to drain the territory 1½ mi. on each side of it, these canals would drain an area three miles wide and an average of about 50 miles in length, or a total of about 150 sq.mi.

Upon such a long narrow strip, the distribution of the rainfall would probably be such that a runoff of not more than ½ in. per 24 hr. need be anticipated. On this basis, the main canal for draining each of these areas should have, at the outlet, a capacity of

150 sq.mi. × 13.44 cu.ft. per sec. per sq.mi. = 2100 cu.ft. per sec.

Such canals would have a mean slope of about 0.2 ft. per mi., and for the capacity estimated should have at their outlets water sections about 110 ft. wide and 12 ft. in depth.

In the actual plans for reclamation, fewer and larger outlets would naturally be used by the union of a number of these canals into a common outlet.

After laying stress upon the inadequateness of the drainage works begun and projected by the state, and urging that the state funds now available be used for "a thorough study of the entire problem," and to providing "adequate outlets to the ocean through artificial and enlarged natural channels, and to the control of Lake Okeechobee," the engineers say that "the successful reclamation of the private lands within the Everglades is largely dependent upon private effort."

The Board then takes up briefly the work which might profitably be entered upon by the Everglade Land Sales Co. and associated companies in the reclamation of its own lands. Whatever else is done, dikes or embankments must be built around the lands of the company to prevent flooding during high water in the Everglades. By way of a dike, the following is proposed:

It is suggested that a narrow trench, 4 ft. more or less in width, be excavated first on the center line of the proposed embankment, the material being taken therefrom being dumped within the lines of the proposed embankment, and that this trench be backfilled with the best available material taken out of the canal adjacent to the embankment, the construction of which will be carried on at the same time.

* * * * While the material in the embankment will be compacted in considerable measure by the process of construction, it will probably be necessary to build it 2 ft. more or less above the final surface decided upon, which has been placed tentatively by us at an elevation of 5 ft. above the present ground surface in order to allow for subsequent shrinkage.

An embankment section 16 ft. wide on top, with side slopes 1½ horizontal to 1 vertical, and with an 8-ft. berm on the inside of the embankment adjacent to the canal, is suggested. The side slopes of the canal may have to be varied, according to the character of the material traversed by it, but can probably be built as steep as 1 to 1, as we found the embankments of a considerable portion of the canals traversed by us were standing successfully on a slope of ½ horizontal to 1 vertical.

The final height necessary for the dikes or circumferential embankments, will, of course, have to be determined after a careful study of the extreme high-water levels prevailing in the Everglades, with allowance for the influence of the canals which have recently been constructed by the state, or which may be added hereafter.

The Board assumed a shrinkage allowance of about 40% "not only in the embankment, but also in the surface of the ground, with reference to its effect upon the water level which may be maintained successfully in the ditches and canals."

As to methods of drainage, consideration is given to gravity, pumping and the two combined, but no definite conclusion is reached, except that "present indications point to the all-pumping project as likely to be the most practicable and advantageous, although the scheme of drainage in part by gravity and in part by pumping has distinct merit if it is feasible."

While further study is needed to determine whether steam, electric or oil power would be preferable, "present evidence indicates that the steam-driven plant will prove more advantageous under existing circumstances."

Annual Convention of the American Electric Railway and Allied Associations

The thirty-second annual convention of what is now The American Electric Railway Association was held in Atlantic City, N. J., Oct. 13 to 17, 1913. Coincident with the meetings of this parent association were the sessions of the allied Accounting, Engineering, Claims and Traffic Associations, and the exhibit of the Manufacturers Association. The parent association meetings were held in the afternoons and the special sessions in the morning so that members could attend both. The entertainment program (card parties, concerts, dances, a frolic night and a golf tournament) was arranged by the Manufacturers Association as its contribution to the success of the convention.

The following officers were elected for the several associations at separate sessions:

AMERICAN ASSOCIATION:

President, C. N. Black (United R.R.s of San Francisco); Vice-Presidents: C. L. Allen (Newport News & Old Point Ry.), Syracuse, N. Y., C. L. Henry (Indianapolis & Cincinnati Traction Co.), J. A. Beeler (Denver City Tramway Co.), L. S. Storrs, New Haven, Conn.; Secretary-Treasurer, E. B. Burritt, New York City.

ENGINEERING ASSOCIATION:

President, J. H. Hanna (Capital Traction Co.), Washington, D. C.; Vice-Presidents, L. P Crecelius (Cleveland Ry. Co.), John Lindall (Boston Elevated Ry.), B. F. Wood (Pennsylvania R.R.), Altoona, Penn.; Secretary-Treasurer, E. B. Burritt (Secretary American Association).

CLAIMS ASSOCIATION:

President, W. F. Weh (Cleveland Ry. Co.); Vice-Presidents: W. Tichenor (Terre Haute, Indianapolis & Eastern Traction Co.), Geo. Carson (Puget Sound Traction, Light & Power Co.), Seattle, R. E. MacDonald (N. Y. State Rys.), Rochester; Secretary-Treasurer, B. B. Davis (Columbus Ry. & Light Co.), Columbus, Ohio.

TRANSPORTATION ASSOCIATION:

President, D. A. Hegarty (New Orleans Ry. & Light Co.); Vice-Presidents, M. C. Brush (Boston Elevated Ry.), H. A. Nicholl (Union Traction Co.), Anderson, Ind., L. C. Bradley (Stone & Webster), Dallas, Tex.; Secretary-Treasurer, E. B. Burritt (Secretary American Association).

ACCOUNTANTS ASSOCIATION:

President, M. W. Glover (Mobile Light & Ry. Co.); Vice-Presidents, T. P. Kilfoyle (Cleveland Ry. Co.), A. H. Kayser (San Diego Electric Ry.), C. S. Mitchell (Pittsburgh Rys. Co.); Secretary-Treasurer, M. R. Boylan (Public Service Ry.), Newark, N. J.

MANUFACTURERS ASSOCIATION:

President, W. H. Heulings, Jr. (J. G. Brill Co.), Philadelphia; Vice-Presidents, E. H. Baker (Galena Signal Oil Co.), New York City; S. H. Blewett (American Car & Foundry Co.), St. Louis, Mo.; Secretary-Treasurer, H. G. McConnaughy (Dearborn Chemical Co.), New York City.

Sessions of the American Association

The address of the president, G. H. Harries (Arkansas Valley Ry., Light & Power Co.), of Louisville, Ky., was a review of the status of the industry and the progress of the Association. He held that electric railways must expect from now on to have to face the financial impossibility of meeting increasing expenses on present rates; increased fares must inevitably come and he believed the most promising plan to be that of having an inner five-cent-fare district in cities and two-cent surrounding zones a mile apart. Companies were warned to watch the development of the motor bus as a competitor. In the association, an important work had been started with the establishing of a rate-research bureau whose benefits to member companies were recited. A warm appreciation was given of work of the retiring secretary (H. C. Donecker, of New York City, who becomes assistant manager of the Public Service Railway, of Newark, N. J.).

Association Work—The report of the retiring secretary and treasurer showed a membership of 400 companies representing 80% of the total earning power of the industry; there are also 2900 individual members. The report of the membership committee showed 39 more companies this year, leaving now no city of appreciable size in the country unrepresented.

The Committee on Cost of Passenger Transportation (J. D. Mortimer, Milwaukee Electric Ry. & Light Co., Chairman) presented its plan to establish immediately a "Bureau of Rate Research" and to maintain it for a trial period of three years. The expense of about $7500 per year is to be borne half by the association and half by contributions of member companies. The scope of the work includes (1) determination of factors affecting cost of service, (2) compilation and distribution of operating data and financial results, (3) study of unusual conditions.

The *Aera* Advisory Committee (C. L. Allen, Syracuse, N. Y., Chairman) discussed the first year's issue of the association magazine, outlining a policy to have the magazine disseminate association news, educate members in the problems of the industry, present to the public the railway side of utility controversies, and print articles on operating technique.

Education—The report of the Educational Committee (Prof. H. H. Norris, Ithaca, N. Y., Chairman) showed that it had kept in touch with technical- and vocational-education development during the year, endeavoring to keep the subject before the members by timely articles in the association magazine *Aera*. The plans previously formulated for employee correspondence courses had not been put into wider service on account of the inattention of company officials to the proposed work.

Joint Pole Lines—A Committee on Joint Use of Poles (W. J. Harvie, Hagerstown & Frederick R.R., Chairman) brought in a proposed form of contract and a specification for joint use on rental basis. (This is a joint committee with the National Electric Light Association and the American Institute of Electrical Engineers.) There was criticism of both sections of the report, so that it was referred back to the committee for study and re-presentation at the mid-year meeting (January, 1914).

Railway Insurance—The Insurance Committee (H. J. Davies, Cleveland Ry. Co., Chairman) reported that it had secured data on experience for the year from only 216 companies and that these showed: $179,881,945 in policies carried; $1,198,564 in premiums paid; $224,895 fire losses; $180,691 recovered or 80.3%; premiums equal to $0.666 per $100; losses $0.1125 per $100; recoveries $0.10 per $100; ratio of loss to premium 18.76%; ratio recovery to premium 15.08%.

Electric-Railway Mail—A Committee on Compensation for Carrying Mail (T. H. Tutweiler, Memphis, Tenn., Chairman) reported (1) an abstract of a bill which it expected to have introduced in Congress and (2) a table of estimated costs of mail service on the Boston Elevated Ry.

Relations with Employees—A report by the Committee on Welfare of Employees (J. J. Burleigh, Public Service Ry., Newark, N. J., Chairman) described the forms of sick benefits, insurance, service annuities and profit sharing which were believed best and recommended the wide establishment of reading, recreation, lunch, bath, sleeping and assembly rooms for employees, and the encouragement of lectures, entertainments and athletic sports. The experience of the Public Service Corporation of New Jersey was cited; its welfare work for 13,420 employees (3654 trainmen) cost $104,800, but resulted in a 31% decrease of employees changes, saving $20 in training each new man, giving decreased accident costs and other economies of keeping experienced men.

W. F. Ham (Washington Ry. & Electric Co.), of Washington, D. C., described the plans in operation by this company giving particular attention to the profit sharing. It had been found that 22½% of gross receipts was absorbed in trainmen's wages and 3½% in accident claims; the company set aside 26% to cover these two items, agreeing to divide the unexpended balance among the employees as extra profits.

H. A. Bullock (Brooklyn Rapid Transit System), Brooklyn, N. Y., outlined advantages found in a self-supporting mutual-benefit association (helped by the company to the extent of giving quarters, equipment, medical service, etc.). Pensions and medical inspection had been established independently by the company; accident benefits and profit sharing had not been established.

Several reports dealt with attempts to secure closer relations between the association and railway employees through sectional organizations. A special Committee on Company Sections (C. N. Duffy, Milwaukee Electric Ry. & Light Co., Chairman) reported inaction on the part of companies and urged the rapid utilization of this aid in developing better employees.

A special Committee on Constitution and By-Laws (C. L. Henry, Indianapolis, Chairman) recommended change in one section to aid in the establishment of sectional associations, by making them non-voting members of the American Association. The organization and conduct of local associations would be promoted by a special committee appointed by the executive committee of the American Association. The report was approved for further action.

Public Relations—A Committee on Federal Relations (A. W. Brady, Anderson, Ind., Chairman) described a year's activities. It commented in particular on (1) the recent U. S. Supreme Court decision which denied jurisdiction of the Interstate Commerce Commission over street railways, (2) the act for valuation of

property of common carriers, (3) proposed and expected steel-car legislation.

There were three addresses on "Tendencies of Public-Utility Regulation." In the first Frank Hedley (Interborough Rapid Transit Co.), of New York City, remarked that there had not been much "administrative assistance" from the New York Commission but that, after several years' effort, the commissioners had learned much about utility business and had developed a strong tendency toward real coöperation. There was now much real municipal coöperation in urban transportation, participation in subway building being noted in Chicago, Boston, Philadelphia and New York. The public was seeing better the need of protecting capital investment.

Papers by Richard McCulloch (United Rys. of St. Louis) and C. L. S. Tingley (American Rys. Co.), of Philadelphia, gave abstracts of the several state laws and court decisions on which present regulation was based.

The report of the Committee on Public Relations (T. N. McCarter, Public Service Ry., Newark, N. J., Chairman) described conferences with the National Electric Light Association and the appointment of a joint committee to confer with the National Civic Federation in the formulation by the latter of a "model public-utility law." Another joint committee has been appointed to endeavor to mold public opinion in favor of the utilities.

"A Model Utility Law" was the title of a paper by W. D. Kerr (Municipal Publishing Co.), of New York City. He described the organization of an executive council on public-utility regulation by the National Civic Federation and its work which had resulted in a tentative bill which it hoped to publish before another legislative season. Such a bill it was hoped would be of wide service in showing the wisest provisions which various states could adopt, being the joint product of prominent representatives (unofficial) of public bodies and public utilities.

Mr. A. D. B. Van Zandt (Detroit United Rys.) in a paper describing the publicity efforts of this company, stated that they had abandoned newspaper advertising in favor of car posters and a company magazine, 100,000 copies of which were distributed on the cars weekly.

FRANCHISES, FINANCE, ETC.—"The Cleveland Situation—Its Economics as Developed in the Arbitration Decision of June 19, 1913," was the subject of an address by C. N. Duffy (Milwaukee Electric Ry. & Light Co.), one of the three arbitrators in the recent dispute with the city. He reviewed the ordinance franchise and the reorganization of the company some three years ago. He maintained that a proper study of the situation would show that safeguards for capital investment had not been secured by the governing ordinance, and that no company could maintain its property on the Cleveland fares, give adequate service and earn 6%. The Cleveland service, he held, was inadequate for the growth of the city in both car operation and track extensions. The actual cost of 37 months' operation was some $3,068,000 more than receipts if proper accident and insurance reserves and capital amortization were made. The rate of return (5% on bonds and 6% on stock) was held insufficient; the investment was not properly protected by the ordinance after the termination of the franchise; the depreciation reserve was being collected by a discredited assessment scheme.

A paper "Financial Aspects of Relief of City Congestion by Subways and Viaducts" by C. S. Sergeant (Boston Elevated Ry.), related the conditions under which his company operated. As a result of this experience he contended that only where a large system concentrates great traffic over a long route are subway trains possible, though in some congested centers surface cars might be diverted over or under streets. The burden should be wholly or partly borne by the community benefited. The method of leasing subways to operating companies, with rental a prior charge over dividends on pre-existing investment, was called unfair in that it throws all risk upon the companies.

Paul Shoup (Pacific Electric Ry.), of Los Angeles, described commendable coöperation between towns and interurban railways in southern California, as an example of possible rural development.

A. M. Harris (Harris, Forbes & Co.), of New York, addressed the association on "Electric Railway Securities from the Investor's Standpoint," outlining first the outgrowth of modern bond houses and their function. He noted a persistent public prejudice against traction systems on account of "overestimates of value indulged in while financing consolidations," and said that, on account of this feeling, the banker felt forced to insist on ample safeguards against the peculiar hazards of (1) rapid depreciation and obsolescence, (2) labor troubles, (3) municipal interference and (4) damage suits. Bankers found traction bonds attractive only when net earnings were about twice the interest charges and reasonable dividends were earned on the stock. To safeguard bonds, the traction companies should secure a reasonable public attitude toward their service, be allowed to earn larger rates of dividends, have relief from burdensome taxes and excessive street maintenance, install fare systems that allowed loss on no part of the business, develop more stable relations with employees, safeguard obligations by careful maintenance of property, use better equipment and safety devices and increase vigilance of employees.

In a most thoughtful address, "Franchise Values," W. M. Wherry, Jr. (Wherry & Mygatt), of New York City, showed how the present confusion of statutes, court decisions, commission rulings, etc., arose from lack of good definitions of "franchise value" and insufficient knowledge of the economics of property value. "Value," he contended, is the advantage of possession as distinguished from cost of acquisition, and property has three elements of value, (1) mere possession, (2) marketability, (3) right to profit from use of it. He argued for use of a property value in rate making which would be the same as for condemnation or taxation, and that "value of service rendered" was a better basis of rates than the profits derived. Cost of service could logically be examined only to secure evidence of extortionate profits. In contrast with these views were those that the state could properly (by police power) take away property value to prevent extortion and where unearned increment had been attained without service.

"Other Elements of Value" was the title of an address by C. M. Rosencrantz (Milwaukee Electric Ry. & Light Co.). He first took up physical valuation; accrued depreciation he had found the most disputed item in this, since there was no approved way of finding life of equipment. He believed courts were favoring as "value," the reproduction cost less depreciation. He gave a historical

development of the concepts of going value, working capital, accident and insurance reserves, etc.

SESSIONS OF THE ENGINEERING ASSOCIATION

The address of the president, Martin Schreiber (Public Service Ry., Newark, N. J.), was a brief review of the trend of association work and an argument for extension of membership. The report of the executive committee and of the secretary-treasurer (H. C. Donecker, Secretary of the American Association, New York City) were both informal; it appeared from them that there were over 2000 members and that the cost of running the association was about $4140, exclusive of the printed transactions, cost which is borne by the parent association.

EDUCATION—For the Joint Committee on Education, William Roberts (Northern Ohio Traction & Light Co.), of Akron, Ohio, the engineering representative, outlined efforts which were to be made to interest member companies in education of employees to increase personal efficiency and thereby decrease cost of operation.

The Committee on Power Generation presented as its report four descriptive papers, all of which are explained by the titles: "Forcing Boilers for Peak Loads," by B. F. Wood (Pennsylvania R.R., Altoona, Penn.); "Boiler Settings, Furnaces Stokers, Etc.," by W. H. H. Wilson (Pennsylvania R.R., Altoona, Penn.); "Automatic Relays and Apparatus to Protect from Shut-Down," by W. H. Sawyer, J. W. Welsh, and G. C. Hall; and "Distant Control of Valves," by Wm. Roberts (Northern Ohio Traction & Light Co.).

CITY-RAILROAD TRAINS—The report of the Joint Committee of the Engineering & Transportation Associations on train operation for city service (H. H. Adams and W. H. Sawyer, chairman) showed the results of continued efforts from last year to secure data and information regarding train operation on street railways as distinguished from interurban service. The committee reported but few specific trials but these strengthened the theoretical deductions of last year's report that a distinct saving should be made by train operation during certain periods of the day over certain portions of the system in most cities. As an appendix to the report, tests made by the Public Service Ry., of New Jersey, to determine the practicability and desirability of two-car city-train operation in city service are given in considerable detail.

The report of the Committee on Electrolysis (A. S. Ritchie, Worcester, Mass., Chairman) comprised a general discussion of corrosion of underground structures by stray currents, this consisting very largely of extracts from reports of the U. S. Bureau of Standards. There were also several pages on the utility of potential surveys on pipe and on methods for determination of current flow in underground structures, together with a summary of the several available methods of minimizing electrolytic corrosion of varied structures.

In the discussion, H. G. Stott (Interborough Rapid Transit Co., New York) described the inadequacy of the "drainage" scheme (feeder-drain cables from positive pipes, etc., running to the power-station negative busbars) in the experience of the Interborough company with its elevated-railway structures where conditions seemed ideal for this system. They had studied every available system and finally had installed insulated negative-return conductors. This had proved nearly perfect, both on elevated and subway. He believed that for protection of buried structures like pipes a combination of (1) return feeders for the rails and (2) insulated joints for branch pipes and taps would be best. A number of speakers dwelt on the necessity of coöperation between railways and parties affected in securing minimum possible injury.

ELECTRIC-RAILWAY SIGNALS—At a joint session with the Transportation and Traffic Association, a report was made by the joint Committee on Block Signals for Electric Railway (J. M. Waldron, Interborough Rapid Transit Co., New York City, Chairman). This committee had been instructed to continue the study of signaling instructions and methods and to make recommendations on use of track circuits and equipment for signaling on suburban and interurban lines. The first definite recommendation was that, for high-speed interurban service, continuous-track-circuit control systems should be used with cheaper form of indicators in preference to less reliable control. Objection was raised to this as shutting the door on the development of signaling—something which the members did not want done in spite of the great advantages of continuous-track-circuit control. The meeting finally adopted a recommendation that "wherever automatic signals were controlled by continuous-track circuits, precedence should be given to cheaper indication in preference to an expensive signal and less reliable control." The second definite recommendation was for light aspects of three-position single-track opposing-protection and car-spacing signals. This was adopted against some slight objection of inadequacy of green as "proceed prepared to stop," it being understood that the Standards Committee would consider both recommendation and objection.

The report gave a number of schemes for signaling double- and single-track suburban and interurban lines, citing them only as instances of practical methods already in use. There was also a digest of block-signal laws in the several states and a long appendix giving descriptions of signal and automatic-stop systems. Another appendix gives a bibliography on block signals for electric railways.

HEAVY ELECTRIC TRACTION—The report of the Committee on Heavy Electric Traction (E. R. Hill, Pennsylvania R.R., New York, Chairman) presented some tentative clearances for overhead wires and collector systems of electrified steam roads with the recommendation that the committee continue the investigation of the subject in coöperation with similar committees of the American Railway Engineering Association finally to establish clearances which could be approved by all interested. The committee recommended that since the development of automatic stops was in an experimental stage no further consideration should be given to the location of such devices on the track structure. However, it was recommended that the space between third-rail clearance line and track should be guarded against encroachment since such space would surely be needed for these devices. In all this committee's work it acted jointly with similar committees of the American Railway and American Railway Engineering Association.

ENGINEERING ACCOUNTING—At a joint meeting of the engineering and accountants' associations, a joint Committee on Engineering Accounting (J. H. Hanna, Capital Traction Co., Washington, D. C., and F. B. Lasher,

Republic Ry. & Light Co., New York, (Chairman) discussed (1) interdepartmental and overhead charges; (2) cost accounting and (3) timekeeping by engineering and accounting departments. The report was largely confined to a description of certain forms found useful in reporting shop costs. The discussion showed a growing appreciation of distributing general organization expense more widely over all work in arriving at an idea of true cost; the practices described showed additions of 7 to 100% on cost of labor and material depending on amount of equipment and supervision required. The engineers present seemed to feel that accountants were not apt to give them the sort of cost data that was needed, while the accountants held that engineers need not dabble in accounting if they would only coöperate by warning in advance of the sort of information needed.

One of the most appreciated reports was that of the Committee on Life of Physical Property (Martin Schreiber, Public Service Ry., Newark, N. J., and R. N. Wallis, Fitchburg & Leominster Street Ry., Fitchburg, Mass., Chairmen). They reviewed the attempts of two previous committees to draw up a life table for street-railway equipment, and discussed the elements that caused differences in life of similar apparatus—use, climate, maintenance, adequacy, obsolescence, human factor, public demand, earnings, etc. They showed that the complexity of each of these elements so affected the useful life that no table could be drawn up which would amount to more than a rough estimate in any specific case. Probable life of property was to be fixed only by careful scrutiny in every case, on account of the important part it played in maintaining integrity of investment and fairness of rates.

In the discussion, William McClellan, of New York City, formerly electrical engineer of the New York Public Service Commission, Second District, and C. M. Larson, chief engineer of the Wisconsin Railroad Commission, approved the committee's conclusions and commended their analysis of affecting conditions. Mr. Larson stated that the Wisconsin Commission had life tables of all utility property, but used them only as a convenient point of departure after actual examination.

ENGINEERING STANDARDS—The Committee on Standards (Paul Winsor, Boston Elevated Ry., Chairman) reported upon the methods, devices, etc., referred to it during the year past (these matters were later presented for further action with the reports of the various originating committees). It also reported the compilation of an "Engineering Manual" containing, in convenient form, all the standard constructions, designs, specifications, devices, the recommended practices, etc. This will be a loose-leaf volume to facilitate annual revision. New procedure for the adoption of standards was reported as revised from the rules made two years ago, cutting out, for instance, letter ballots and substituting approval of the executive committees of this and the parent association.

The report of the committee on Power Distribution (G. W. Palmer, Jr., Bay State Street Ry., Boston, Mass., Chairman) presented a hundred odd pages of specifications, etc., for consideration as "standards" and "recommended practices." These were not quietly passed through but had to endure a searching discussion, though generally with a good defense by the committee. A proposed standard specification for rubber-insulated wire for electric-railway power circuits was referred back to committee; a design of cap-and-cone trolley-wire insulator supports was adopted, as were standard specifications for tubular steel and wood poles and revisions of the specifications for overhead railway crossings of electric-light and power-transmission lines which had been drawn up by a joint committee of the National Electric Light, American Electric Railway, American Railway and other associations and adopted in 1911. Specifications for reinforced-concrete poles were presented for criticism, but without proposal to adopt. Specifications for "recommended practice" in the construction of 600-volt overhead-trolley construction were adopted.

The Committee on Way Matters (J. M. Larned, Pittsburgh Rys. Co.) reported the completion of the work of several past committees in formulating standards for rails. They presented, and the meeting adopted as standard, designs for 7-in. and 9-in. girder grooved rail sections and 7-in. and 9-in. girder guard rails. They brought in as "recommended practice" designs of joint plates for these rails and the meeting so adopted them. It was stated that they were not adopted as standards since such action might seem to discourage use of other types of rail joints. The committee also reported a specification for manufacture of splice bars, which was adopted as "recommended practice"; some revised specifications for openhearth girder and high T-rails, superseding specifications adopted a year ago, were adopted as "recommended practice." It was explained that these last were substantially as before, but showed changes in form desired by the American Society for Testing Materials. There was a little criticism of the standard rail sections as being too light in the base to stand electrolysis and so light in the web as to lead to corrugation in use.

The report of the Committee on Equipment (F. R. Phillips, Pittsburgh Rys. Co., Chairman) presented for criticism and discussion some preliminary outlines of best methods of car wiring, some notes on air-hose troubles and some descriptions and operating data of storage-battery cars. The committee also reported on standard specifications for solid wrought carbon-steel wheels for electric cars, explaining their opposition to the adoption at this time of a standard which, nevertheless, the American Society for Testing Materials had just done. The meeting voted to return the matter to committee for further work. The committee recommended, and the meeting voted, to have the existing standard brake-shoes revised to eliminate minor crudities and to incorporate improvements.

The report of the Committee on Buildings and Structures (R. M. Pinkley, Milwaukee Electric Ry. & Light Co., Chairman) presented (1) a review of present practice in carhouse construction and (2) a set of fire-protection rules. The latter at the suggestion of the Standards Committee were referred back to the committee that they might be put before the National Fire Protection Association to be made consistent with other codes.

PROGRAMS OF OTHER ASSOCIATIONS

The following programs of the other affiliated associations are briefly noted as of engineering interest.

ACCOUNTANTS ASSOCIATION

Reports of Committees: (1) Education—F. J. Pryor, Jr., Chairman (American Rys. Co.), Philadelphia, Penn. (2) Destruction of Records—H. S. Swift, Chairman (Toledo Ry. & Light Co.) (3) Standard Classification of Accounts—H. L.

Wilson, Chairman (Boston Elevated Ry.) 4. Convention of Railway Commissioners—W. F. Ham, Chairman (Washington Ry. & Electric Co.) (5) Prepayment Car Operation, Chairman, M. R. Boylan (Public Service Ry. Co.), Newark, N. J. (6) Fares and Transfers—Chairman, F. T. Wood (New York Rys. Co.) (7) Express and Freight Traffic—F. D. Norviel, Chairman (Union Traction Co.), Anderson, Ind. (8) Express and Freight Accounting—Walter Shroyer (Union Traction Co.), and J. F. Choate (J. G. White Management Corporation), New York, N. Y., Chairmen. (9) Statistical Unit for Car Operation—C. H. Lahr (Northern Ohio Traction Co.), Akron, Ohio, and C. B. Buchanan (Virginia Ry. & Power Co.), Richmond, Va., Chairmen. (10) Best Methods of Collecting and Accounting for Variable Rates of Fare—M. R. Boylan, Chairman (Public Service Ry.), Newark, N. J. (11) Interline Accounting—L. T. Hixson, Chairman (Terre Haute, Indianapolis & Eastern Traction Co.) (12) Coöperating with the U. S. Bureau of Census. A. L. Linn, Jr., Chairman (Harrison Williams), New York. (13) Overhead Charges—P. S. Young, Chairman (Public Service Ry.), Newark, N. J.

Papers and Addresses: (1) "Sinking Funds," W. H. Forse, Jr. (Union Traction Co.), Anderson, Ind. (2) "Statistical Units Used in Analysis of Electric Railway Accounts," J. A. Emery (Ford, Bacon & Davis), New York. (3) "A Unit-Cost Work-Order System," G. W. Kalweit (Milwaukee Electric Ry. & Light Co.) (4) "Accounting Department of Conferences," F. B. Lasher (Republic Ry. & Light Co.), New York. (5) "The Census of Electric Railways," W. M. Steuart (Chief Statistician for Manufactures, Bureau of Census), Washington, D. C. (6) "Overhead Charges," Henry Floy (Consulting Engineer), New York.

CLAIMS ASSOCIATION

Papers: (1) "Mechanical Devices for Preventing Accidents," J. J. Reynolds and M. P. Spillane (Boston Elevated Ry.) (2) "The Investigation of Street Railway Accident Cases," W. P. Christiansen (Chicago Rys. Co.) (3) "The Prevention of Accidents," H. V. Drown (Public Service Ry.), Newark, N. J. (4) "The Value of Safety Committees," George Carson (Puget Sound Traction, Light & Power Co.), Seattle, Wash. (5) "Motor Vehicles," M. B. Bracken (United Rys. of St. Louis). (6) "Adjustment of Accident Claims," F. D. Edmunds (Interborough Rapid Transit Co.), New York.

TRANSPORTATION AND TRAFFIC ASSOCIATION

Committee Reports: (1) Individual Membership—L. C. Bradley, Chairman (Stone & Webster), Dallas, Tex. (2) Uniform Definitions—M. C. Brush, Chairman (Boston Elevated Ry.) (3) Rules (Consolidated)—F. A. Boutelle, Chairman. (4) Construction of Schedules and Timetables—J. E. Duffy, Chairman (New York State Rys.), Syracuse, N. Y. (5) Training of Transportation Employees—C. B. Wells, Chairman (Denver City Tramway Co.) (6) Passenger Traffic—J. E. Gibson, Chairman (Kansas City Ry. & Light Co.)

Addresses: (1) "Factors Affecting the Cost of Passenger Service," Edwin Gruhl (Milwaukee Electric Ry. & Light Co.) (2) "Regulations on Sanitation, As Relating to Public Carriers," W. P. Rucker, M. D. (Assistant Surgeon General, U. S. Bureau of Public Health), Washington, D. C.

NOTES

The Garbage Disposal Situation in Chicago has taken another turn. The mayor, who has been opposed to acquiring the plant of the Chicago Reduction Co., has approved an ordinance providing for its purchase by condemnation, although the plant is said to be in such condition that its use can be only a temporary expedient. Experiments with the proposed deodorant treatment have not been very satisfactory, and the proposed reduction treatment with the same chemical appears to have little value. The inventor, J. M. Hirsh, is reported to have declined to allow an investigation of his secret solution by chemists, but he explained some of his ideas at a meeting of the Chicago section of the American Chemical Society. Extravagant statements made as to saving in fuel consumption and recovery of valuable by-products were disproved during the discussion. The situation is now largely in the nature of a factional fight. The people in the neighborhood of the clay pits oppose disposal by dumping, and the people in the neighborhood of the present reduction plant and of proposed new plants, oppose the disposal by reduction. The aldermen represent their wards only and reflect the ideas of their constituents, so that the interests of the city as a whole are practically not represented in the controversy.

The Rear Collision on Sept. 2, on the Midland Ry., in England, at Aisgill, was the most serious railway collision which has occurred on a British railway since 1867. Fourteen persons were killed in the collision and ten were seriously injured. A thorough investigation of the accident has been made by the engineer-expert of the Board of Trade, Col. Pringle. The investigation establishes that the collision was due to the failure of the driver of the following train, which caused the collision, to observe the signal set at danger at the entrance of the block in which the train which suffered in the collision was standing. The excuse the driver gave for not observing the signal was that he was busy at the front of the engine oiling the valve motion when he passed the signal and so did not observe it.

The fire which followed the collision and which was at first reported to have been due to the gas lighting system employed, has now been determined to have been set by coals from the locomotive firebox. Such fatal collisions as that at Aisgill are almost unknown in British railway experience. The very low rate of fatality in British railway travel is shown by the statement that according to official statistics of the Board of Trade, the total number of passengers killed in all train accidents from all causes whatever on all British railways during 1912 was only 20. The total number of passengers carried during the year, including holders of season tickets, was 1,294,000,000, exceeding by nearly 25% the total number of passengers carried on all the steam railways of the United States.

A Troop Train Plunged into a 60-Ft. Ravine, from the Buckatonna trestle near State Line, Miss., 60 mi. north of Mobile, Ala., on the Mobile & Ohio R.R., on Oct. 19. According to press dispatches 25 soldiers were killed and 100 injured; of the latter, 20 probably will die. The locomotive passed safely over the trestle, but the tender and the three coaches fell through into the ravine, carrying with them four officers and 175 enlisted men of the 170th and 37th companies of the U. S. Coast Artillery stationed at Fort Morgan, Ala., who were going to Meridian, Miss., to attend the Mississippi State Fair.

The German Dirigible Airship "Zeppelin L-2" Exploded on Oct. 17, while at an elevation of over 600 ft. above the outskirts of Johannisthal, Germany. The "L-2," which was about 500 ft. in length, was the latest of the aërial war craft built by the Zeppelin Co. for the German navy, and was on her trial trip at the time of the accident. The explosion of the gas bag was followed by that of the gasoline tank, which contained more than a ton of fuel. Of the 28 persons on board at the time, 27 were killed. Those on the ship included the Admiralty board (consisting of a captain, lieutenant-commander, two naval architects, and a naval engineer) and a number of naval warrant officers. Six other Zeppelin airships have been destroyed by fire, explosion, or wreck: "Zeppelin 1," "2" and "6," "Deutschland 1" and "2," and the "L-1." The "L-1" was blown to sea by a violent gale on Sept. 9 and broke in half when she struck the water.

A Vertical Water-Tube Boiler Exploded in the generating station of the Richmond Light & Ry. Co., at Livingston, S. I., at 4:30 p.m., on Oct. 21. Six men were killed, four were injured, service on five of the six electric car lines of Staten Island was discontinued (the sixth was operated from the Concord station owned by the same company) and the electric-lighting system of the entire island was out of commission all night. The boiler, which was one of a bank of three Wickes boilers installed in 1901, was blown through the roof of the station and dropped bottom downward into the waters of the Kill van Kull. An explanation of the accident can be obtained only when the boiler is raised and examined. No stop-valves were provided between the several boilers in the battery and the steam, which is carried at a pressure of 180 lb., had to be shut off from the main line. The other boilers in the bank were uninjured except for the damage to the brickwork.

PERSONALS

Mr. G. N. Howson, Master Mechanic of the Southern Ry., at Princeton, Ind., has been promoted to be Superintendent of the Louisville division, at Louisville, Ky.

Mr. M. J. Wise, Superintendent of the Southern Railway Co., in Mississippi, at Columbus, Miss., has been promoted to be Assistant to the General Manager, with headquarters at Mobile, Ala.

Mr. Henry W. Miller, recently Assistant to the President of the Southern Ry., at Atlanta, Ga., has been elected President of the Kentucky & Indiana Terminal R.R. Co., at Louisville, Ky.

Mr. A. O. Krieger, formerly Publicity Manager of the Busch-Sulzer Bros.-Diesel Engine Co., St. Louis, Mo., has been appointed to take charge of the gasoline-engine sales department of the Whitman Agricultural Co., St. Louis.

Mr. Albert T. Canfield, formerly Architect of the Missouri, Kansas & Texas Ry. system, at Dallas, Tex., has re-entered the service of the Kansas City Terminal Ry., Kansas City, Mo., and his former office at Dallas has been abolished.

Mr. C. E. Denney, Signal Engineer of the Lake Shore & Michigan Southern R.R., at Cleveland, Ohio, has been promoted to be Special Engineer on the staff of the Vice-President in charge of operation, J. J. Bernet, at Chicago, Ill.

Mr. J. E. O'Brien has resigned as Superintendent of Motive Power of the Western Pacific Ry., at San Francisco, Calif., to become Assistant Mechanical Superintendent of the Missouri Pacific Ry. system, with headquarters at St. Louis, Mo.

Mr. Edward St. Clair Smith, Assoc. M. Am. Soc. C. E., County Engineer and Director of Highways at Gooding, Idaho, has been appointed State Highway Engineer of Idaho. A comprehensive system of state highways is to be built in conjunction with the counties.

Dr. Ira N. Hollis, Vice-President, Am. Soc. M. E., was honored by the Massachusetts members of the society on Oct. 17, by a meeting and banquet in Worcester, Mass., where Dr. Hollis has recently entered upon his duties as President of the Worcester Polytechnic Institute.

Mr. Frank H. Flynn, recently Trainmaster of the Boston & Maine R.R., at Boston, Mass., has been promoted to be Superintendent of the Fitchburg division at Boston, succeeding Mr. James D. Tyter, whose appointment as General Superintendent was noted in our issue of last week.

Mr. William T. Donnelly, M. Am. Soc. M. E., Consulting Engineer, New York City, sails from San Francisco, Calif., Oct. 28, for Honolulu, H. I., to make extensive tests of a 5000-ton floating dry-dock for the Inter-Island Steam Navigation Co. He will not return to New York City before the latter part of December.

Mr. Frank M. Williams, M. Am. Soc. C. E., has returned to his home in Goshen, N. Y., having completed the preliminary work for the improvement of 900 miles of highways in Portage County, Ohio. This work is being done under the auspices of the Portage County Improvement Association, organized by Mr. Dan R. Hanna, whose summer home is in this county.

Mr. Charles P. Clark, who recently retired as Vice-President of the Buffalo & Susquehanna R.R., has been engaged by the Massachusetts Public Service Commission as an expert on railway affairs. Mr. Clark was formerly General Manager of the New England R.R., and from 1898 to 1903 he was General Superintendent of the Eastern district of the New York, New Haven & Hartford R.R.

Mr. James G. Woodworth, recently Traffic Manager of the Northern Pacific Ry., at St. Paul, Minn., has been elected Vice-President in charge of traffic. Mr. Woodworth was born at Hillside, Mich., Oct. 31, 1864. His railway experience began when he was 15 years old as an office boy in the general freight department of the Chicago & Northwestern Ry. He was promoted through the freight traffic departments of various Western railways and in 1905 resigned as Assistant to the Vice-President of the Chicago, Burlington & Quincy R.R. to become Traffic Manager of the Northern Pacific Ry.

Mr. Harrison R. Fehr, M. Am. Soc. C. E., President and General Manager of the Easton (Penn.) Transit Co., has been elected President of the Lehigh Valley Transit Co., with offices at Allentown, Penn. Mr. Fehr's engineering experience began at 20 years of age, in 1883, as a rodman with the Lehigh Valley R.R. He was promoted in 1886 to be transitman, and two years later to be Assistant Engineer. From 1891-1899 he was City Engineer of Easton. After several years as a contractor for the construction of electric railways he was made General Manager of the Easton Transit Co., later being elected President.

Maj. Charles De L. Hine has resigned his office of Vice-President and General Manager of the Southern Pacific R.R. of Mexico, the Sonora Ry. and the Arizona Eastern R.R., with office at Tucson, Ariz., to re-engage in private practice as a railway organization expert, with temporary headquarters at Toronto, Ont., where he will be employed by the Canadian Northern Ry. His permanent headquarters will be in New York City. Quite a complete account of Maj. Hine's notable career as an army officer, lawyer, railway trainman and railway executive was published in our personal columns of Feb. 1, 1912, at the time of his election to the general-managership of the Southern Pacific R.R. of Mexico. In recounting his experiences in this capacity at a recent meeting of the St. Louis Railway Club, Maj. Hine gave a very interesting picture of railway operating conditions during the present political chaos in Mexico.

Mr. George H. Benzenberg, Past-President, Am. Soc. C. E., Consulting Engineer, Milwaukee, Wis., has been elected Chairman of the new Milwaukee Sewerage Commission, noted on p. 780 of our issue of last week. Mr. Benzenberg was one of the five citizens originally appointed by the Mayor, but at first declined to serve. Mr. Benzenberg was City Engineer and President of the Board of Public Works of Milwaukee for 17 years, 1882-1899. Under his supervision some of Milwaukee's most important public works have been constructed, including the high-pressure pumping station, the waterworks tunnel and intake cribs, the re-design of the city sewerage system, and the Milwaukee River flushing tunnel. He has also been prominently identified as Consulting Engineer with the public works of the cities of Chicago, Kansas City, Cleveland, New Orleans and Cincinnati. The members of the new sewerage commission have many and extensive duties but no salaries.

Mr. John N. Carlisle, Commissioner of Highways of New York State, has announced a complete reorganization of the State Highway Department. The state has been divided into nine divisions, each in charge of a Division Engineer, and a fixed allotment of the state road fund is to be expended in each. Mr. Carlisle has announced the following appointments of Division Engineers:

Mr. Bertram H. Wait, Assoc. M. Am. Soc. C. E., Division Engineer, Board of Water Supply, City of New York, has been appointed Division Engineer of the First division, which comprises the counties of Suffolk, Nassau, Westchester, Putnam, Dutchess, Columbia, Greene, Ulster, Orange and Rockland. The division headquarters will be in Poughkeepsie, and on account of the large amount of highway work on Long Island a Resident Engineer will be located there, who will be in charge of all the work on Long Island; $10,972,000 is to be expended on this division. Mr. Wait is 33 years of age, and was graduated from Cornell University in 1902. He has had charge of the paving work in the city of Syracuse and was in charge of a section of the work under the Rapid Transit Commission in New York City from 1902 to 1907. He has been in charge of water-supply work for New York City from 1911 to the present time.

Mr. Harvey O. Schermerhorn, Assoc. M. Am. Soc. C. E., Resident Engineer, New York State Canals, Terminal Engineer's office, Albany, N. Y., has been appointed Division Engineer of the Second division, comprising the counties of Albany, Rensselaer, Schenectady, Saratoga, Washington, Warren, Essex and Clinton. The division headquarters will be in Albany, and an office of a Resident Engineer will be located at Plattsburg, which will have charge of the work in that section of the Adirondack district; $8,331,000 is to be expended in this division. Mr. Schermerhorn is 33 years old, and was graduated from the Rensselaer Polytechnic Institute in 1903. He has had an extensive experience on the Barge Canal construction, including culverts, bridges and highways. He has been Resident Engineer in charge of Barge Canal construction work in the Erie residency No. 1 at Waterford, and had charge at that place of contract work aggregating $1,700,000.

Mr. Theron M. Ripley, M. Am. Soc. C. E., Resident Engineer, New York State Canals, Fulton, N. Y., has been appointed Division Engineer of the Third division, comprising the counties of Lewis, Jefferson, St. Lawrence and Franklin; the division headquarters are to be continued in Watertown; $6,366,000 is to be expended on this division. Mr. Ripley is 44 years of age and received a special course in civil engineering at Marietta College. His engineering experience covers the supervision of city parks in Manila, P. I., construction work at Marietta, Ohio, and Barge Canal work in New York. He has constructed and paved several streets in Marietta, Ohio, and in Williamstown, W. Va., and was a state representative to the Road Congress in St. Louis during the St. Louis Exposition. He is now in charge of the Oswego residency of the State Engineer's Department.

Mr. James H. Sturdevant, Assoc. M. Am. Soc. C. E., remains Division Engineer in charge of the Fourth division, comprising the counties of Montgomery, Fulton, Hamilton, Herkimer, Oneida and Madison, with division headquarters in Utica; $6,314,000 is to be expended in this division.

Mr. Howard E. Smith, M. Am. Soc. C. E., Resident Engineer, New York State Highway Department, has been appointed Division Engineer of the Fifth division, comprising

the counties of Broome, Chenango, Otsego, Schoharie, Delaware and Sullivan, with the division headquarters in Binghamton; $6,117,000 is to be expended in this division. Mr. Smith is 43 years of age. He was educated at the Rensselaer Polytechnic Institute and Union University, and was graduated from the Massachusetts Institute of Technology in 1906. He has been connected with the Highway Department since 1909.

Mr. Charles J. McDonough, M. Am. Soc. C. E., Resident Engineer, New York State Barge Canal Terminals, Buffalo, N. Y., has been appointed Division Engineer of the Sixth division, comprising the counties of Cortlandt, Cayuga, Seneca, Wayne, Onondaga and Oswego. The division headquarters will be continued in Syracuse. The sum of $6,219,000 is to be expended. Mr. McDonough is 39 years of age, a graduate of the Rensselaer Polytechnic Institute, and has had charge of maintenance of the paved streets in the city of Buffalo and has been Assistant Engineer in highway work in the State Engineer's office. More recently he has been employed as Acting Resident Engineer on the Barge Canal work.

Mr. Perry Filkin remains as Division Engineer of the Seventh division, comprising the counties of Wyoming, Genesee, Orleans, Monroe, Livingston and Ontario. Division headquarters will be in Rochester and $5,779,000 will be expended.

Mr. Frederick S. Strong remains as Division Engineer of the Eighth division, comprising the counties of Allegany, Steuben, Yates, Schuyler, Chemung, Tioga and Tompkins. Division headquarters will be in Hornell and $5,641,000 will be expended.

Mr. William E. Acheson has been appointed Division Engineer of the Ninth division, comprising the counties of Niagara, Erie, Chautauqua and Cattaraugus, with division headquarters in Buffalo; $7,593,000 will be expended in this division. Mr. Acheson is 35 years of age, a graduate of the Rensselaer Polytechnic Institute and Union University and has had an extended experience in the construction of roads, sewers and the laying of water pipes in the Panama Canal Zone, where he entered the employ of the U. S. Government as a leveler and was promoted to the position of Assistant Engineer. More recently he has been Supervising Engineer for the County Construction Co. and has had charge of the construction, resurfacing and repairing of many miles of highways in the State of New York. He also has had extended experience in highway work in connection with street improvement in the city of Troy.

The six new Division Engineers were selected from a certified list of the State Civil Service Commission after a rigid examination. Regarding these appoints, Mr. Carlisle is quoted as follows:

These men were told before their appointment that their tenure of office depended upon their ability to make good and that if they did make good, so long as I was Commissioner, no political influence could be exerted that would remove them, and if they failed to make good, no political influence could be exerted that would retain them in their positions. They were selected as engineers on their merits, and they are coming into the department with the determination to put the department on a high plane.

OBITUARY

Joseph Robinson Parrott, President of the Florida East Coast Ry., died at his summer home in Oxford, Maine, Oct. 13. He was born in Oxford, Oct. 30, 1859, and graduated from Yale College and Law School. His railway work began in 1885 as an attorney for the Jacksonville, Tampa & Key West Ry. Subsequently he was General Counsel and Land Commissioner. He was elected Vice-President of the Florida East Coast Ry. in 1892; later he was made President and under his administration the famous Key West extension was completed.

ENGINEERING SOCIETIES

COMING MEETINGS

NATIONAL ASSOCIATION OF RAILWAY COMMISSIONERS.
Oct. 28. Annual Convention at Washington, D. C. Secy., Wm. H. Connolly, Interstate Commerce Commission, Washington, D. C.

NATIONAL CONSERVATION CONGRESS.
Nov. 18-20. Annual meeting at Washington, D. C. Secy., T. R. Shipp, Indianapolis, Ind.

GREAT LAKES INTERNATIONAL PURE WATER ASSOCIATION.
Nov. 6-7. Meeting at Toronto, Ont. Secy., Paul Hansen, Urbana, Ill. Meeting postponed until further notice.

UNITED STATES GOOD ROADS ASSOCIATION.
Nov. 10-16. Third annual meeting at St. Louis, Mo. Secy., J. M. Rountree, Birmingham, Ala.

NATIONAL FOUNDERS' ASSOCIATION.
Nov. 19-20. Annual convention at New York City. Secy., J. M. Taylor, 29 So. La Salle St., Chicago, Ill.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS.
Dec. 2-5. Annual meeting in New York. Secy., Calvin W. Rice, 29 W. 39th St., New York City.

AMERICAN SOCIETY OF REFRIGERATING ENGINEERS.
Dec. 1-2. Annual meeting in New York Secy., W. H. Reed, 154 Nassau St., New York City.

ASSOCIATION OF AMERICAN PORTLAND CEMENT MANUFACTURERS.
Dec. 8-11. Annual meeting in New York. Secy., Percy H. Wilson, Land Title Bldg., Philadelphia, Penn.

AMERICAN ROAD BUILDERS' ASSOCIATION.
Dec. 9-12. Annual convention at Philadelphia, Penn. Secy., W. H. Tolman, 29 W. 39th St., New York City.

AMERICAN INSTITUTE OF CHEMICAL ENGINEERS.
Dec. 10-13. Annual meeting in New York. Secy., J. C. Olsen, Polytechnic Institute, Brooklyn, N. Y.

SOCIETY OF NAVAL ARCHITECTS AND MARINE ENGINEERS.
Dec. 11-12. General meeting in New York. Secy., D. H. Cox, 29 W. 39th St., New York City.

The American Institute of Electrical Engineers—Upon the petition of the Panama members of the institute and the recommendations of the Sections Committee, authority was granted by the Board of Directors, on Oct. 10, to organize a section in the Canal Zone to be known as the Panama Section.

Vermont Society of Engineers—At the 2d annual fall meeting of the society, at Burlington, Vt., on Oct. 8, an illustrated lecture was given on hydrographic surveys dealing principally with stream flows and methods of measurement, by C. C. Covert, District Engineer of the U. S. Geological Survey.

Engineers Club of St. Louis—The program for the meetings this season includes the following papers: Oct. 29, "The Federal Valuation of Railways," F. G. Jonah, Chief Engineer of Construction, St. L. & S. F. Ry. Nov. 5, "Railroading Sixty Years Ago," C. de la C. Purdon, Chief Engineer, St. L. S. W. Ry. Nov. 19, "The Law of Contracts," A. A. Aergerter.

American Society of Mechanical Engineers—A tentative program has been prepared for the annual meeting to be held in New York, Dec. 2-5, A notable feature is the presentation by the Verein Deutscher Ingenieure of the Grasshof Medal, to George Westinghouse, Past President and Honorary Member, Am. Soc. M. E. Following the presentation, John W. Lieb, Past President of the Am. Inst. E. E., will deliver an illustrated lecture on the life of Leonardo da Vinci, engineer and artist.

The American Bridge Engineering Club of New York—The membership of this club is composed of the employees of the American Bridge Co. The organization, which is backed by the officers of this corporation, has for its object a closer relationship between the members and the company and the higher efficiency of the men. Monthly meetings and dinners will be held at which technical papers will be read and discussed. The first regular meeting and dinner was held on Oct. 1. The Secretary-Treasurer is James Rome.

Los Angeles Association of Members of the American Society of Civil Engineers—Forty members of the American Society of Civil Engineers dined at the Sierra Madre Club, at Los Angeles, Calif., on Oct. 14, for the purpose of forming a local organization of members of the society. Temporary officers were elected as follows: President, J. B. Lippincott; Secretary, W. C. Sawyer. A committee consisting of A. C. Hansen, Chairman, G. S. Binkley, Fulton Lane, J. R. Comly, and W. K. Barnard, will report a plan of permanent organization.

Pacific Association of Consulting Engineers—At the annual meeting held at San Francisco, on Sept. 26, the principal feature was an address by the retiring president, C. D. Marx. Mr. Marx described the papers and discussions at the International Congress of Consulting Engineers, held in Ghent, Belgium, July 18-21. He made particular mention of the paper entitled "Suggestions Upon a Proposed International Association of Engineers," by E. L. Corthell, delegate from the American Institute of Consulting Engineers. The following officers were elected for the ensuing year: President, C. D. Marx; Secretary-Treasurer, C. Derleth, Jr.